



MONTGOMERY COUNTY FIRE AND RESCUE SERVICE DRIVER/OPERATOR TRAINING PROGRAM

TRAINING SUPPLEMENT BRUSH TRUCK

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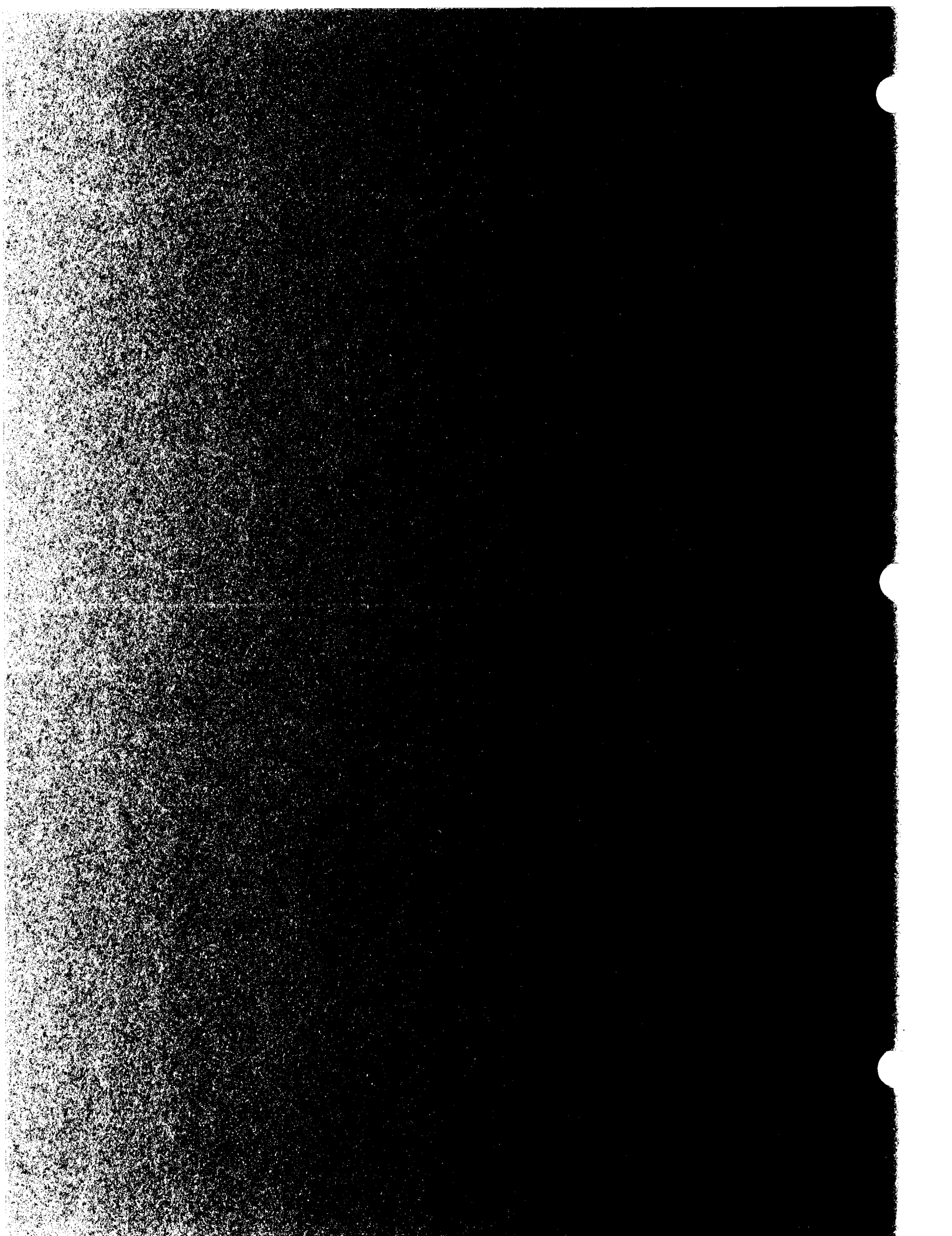
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Emergency Vehicle Inspection, Preparation, And Driving Techniques

INTRODUCTION

The intent of this portion of the manual is to provide the candidate with the information needed to safely and efficiently operate emergency apparatus. This section includes but is not limited to vehicle knowledge and inspection, general operation and safety features of the vehicle, and proper driving techniques in normal as well as emergency operations.

The candidate must be completely knowledgeable in all aspects of the vehicle they intend to operate. It is important the candidate is able to demonstrate safe driving habits and is fully knowledgeable of the safety features inherent to the vehicle. The candidate shall be able to identify the various components of the vehicle and explain their use. The candidate will be able to identify any defects, make minor repairs, and understand when the vehicle is to be placed out of service due to safety reasons or major defects. In turn the candidate will be able to complete the necessary documentation required by the Department.

OBJECTIVES

Upon completing this module of the Driver Training Manual, the candidate will be able to correctly identify, maintain, evaluate, adjust, and operate an emergency vehicle. This will involve: being able to identify major components of an emergency vehicle and being able to prepare the vehicle for an emergency response. These operations will include - preventive maintenance, pre-response preparation, safety checks and adjustment. The candidate will know, understand, and successfully demonstrate safe and correct handling of the vehicle in routine, emergency, and dangerous driving situations.

VEHICLE INSPECTION AND DRIVING PREPARATION

Major Motor Vehicle Components

There are many motor vehicle components to be discussed when describing any motor vehicle and some are specifically associated with emergency vehicles. The following is a list of components covered in this section:

- Vehicle characteristics – height, weight, length, and width
- Motor / engine components
- Braking systems: drum, disc, air, ABS, and engine retarders
- Exhaust systems
- Driveline
- Steering system
- Electrical system
- Suspension
- Wheels and tires

VEHICLE CHARACTERISTICS

The characteristic of an emergency vehicle affects the impact on the physical forces of the vehicle. The **height, weight, length, and width** of the vehicle are those items that are going to affect to the action and reaction of the vehicle while it is in motion. These items limit the direction of travel of the vehicle due to weight limitations (bridges), height constraints (overpasses), and width restrictions (tunnels).

Height: It is important to know the *overall* height of the vehicle including all lights and other equipment mounted on the top of the vehicle. The operator should be able to recognize not only structural overhangs but also other potential problems, for example tree limbs, power and phone lines, and any other low hanging objects. It is also important to understand the vehicle height plays a roll in how the vehicle is going to handle in terms of braking and turning. The taller the vehicle is the higher the center of gravity. This is important when making turns. Because the center of gravity is higher, the potential for rollover is higher if the vehicle is exceeding a safe turning speed. This higher center of gravity changes the braking on the vehicle as well.

Weight: The GVW (gross vehicle weight) is vital to know because of bridge and road limitations. It is important to remember that there is a safety factor assigned for every weight limitation on bridges. This is done to provide a GVW allowance to safely cross a given bridge. The posted weight is much less than the actual weight limit that the bridge or overpass can take. However, alternate paths should be considered when possible to avoid crossing those bridges that are

weight of the vehicle. As with height, the weight of the vehicle is a major influence on the vehicles handling. The weight of the vehicle has a direct impact on the braking system. The weight distribution between the front and rear axle must be appropriately distributed. When at all possible the vehicle should have approximately 1/3 the weight over the front axle and 2/3 of the weight over the rear axle. Additionally the weight should be distributed evenly from side to side when possible. If the distribution is done correctly the braking system will work to maximum capability.

Length: The length of the vehicle is important to know in terms of turning radius (wheel base contingent) and angle of approach and angle of departure. It is safe to assume that the longer the vehicle the wider the turning radius must be. The angle of approach and departure are important when moving across hills. These are the smallest angles made between the road surface and a line drawn from the point of ground contact and either the front or rear of the tire to any projection of the apparatus. This is important so that the front or rear bumpers or any object of the undercarriage of the vehicle does not come into contact with the road surface.

Width: The width of the vehicle comes into play when driving into diminished clearance environments. It is important that the width of the vehicle is the *overall* width that includes mirrors and any piece of equipment mounted to the exterior of the vehicle.

MOTOR/ENGINE COMPONENTS

There are two types of engines, gasoline and diesel. Their components are very similar in nature. The primary concern to the operator is the type of fuel used by the engine. Care should be taken to ensure the proper fuel is used. The following is a list of the basic components in the motor compartment of the vehicle.

Engine Block: The engine block is where the pistons perform the work to create the motion of the vehicle. The block becomes extremely hot during the operation of the vehicle. Oil and antifreeze pass through the block during its operation.

Radiator: The radiator contains the fluid used to keep the engine block from overheating. The cooling system is a closed system working under a vacuum.
**** NOTE **** The fluid in this system becomes extremely hot and should not be handled until cooled.

Battery(s): The batteries are the start of the electrical system. They are used in starting the vehicle and maintain electrical components during the operation of the vehicle. The standard starting circuit contains two 12-volt batteries wired in parallel. On some vehicles there is a selector switch to opt for either or both batteries. The switch indicates which battery is being charged. It is important to note not to turn off the battery switch while the engine is running. This will cause damage to the alternator and electrical system. If the batteries need to be charged, only charge one at a time, and not both, on the selector switch. Charging both could cause one battery to receive an excessive charge, causing the contents to boil, resulting in battery damage or destruction. **** NOTE **** The battery (s) contain acid which will harm you if you come in contact with it.

Power Steering Pump: The power steering pump maintains the fluid used to assist in steering the vehicle. The fluid in this system can be checked either while the engine is cold or hot. There are differentiating indicator marks on the dipstick for this purpose.

Brake Master Cylinder: This unit contains the fluid used to operate the braking system. **** NOTE **** This is not used with air braking systems.

Fan/Accessory Belts: These belts are used to turn the cooling fan for the radiator and provide a means of recharging the batteries through the alternator.

BRAKING SYSTEMS

A vehicle's braking system is comprised of fluids that transmit forces to the vehicle wheel brakes. This is either done by a hydraulic (liquid) system or a pneumatic (air) system.

There are generally two types of braking devices that can be on the vehicle, *drum* and/or *disc* brakes. *Drum* brakes are two brake shoes that push outward and press the drums when the brakes are applied. The pressure on the brake pedal causes fluid or air to flow into the brake cylinder. The cylinder moves the brake shoe outward against the brake drum (inner surface of the metal wheel). The pressure of the shoe against the drum causes the wheel to slow or stop. *Disc* brakes are comprised of a rotor and a caliper that squeeze the brake pads to stop the vehicle. The rotor is the disc and is attached to the wheel axle. When the brake pedal is depressed, a hydraulic piston in the caliper causes the caliper to squeeze together, bringing a pair of brake shoes into contact with the rotor. The friction of the opposing brake pads as they squeeze the rotor slows the rotor rotation and causes the wheel to slow and stop.

It is important to break down the pneumatic (air) system into its components because most of the apparatus is equipped with "air brakes". Air brakes use compressed air to make the brakes work. An air brake system is comprised of three (3) different systems: service brake, parking brake, and emergency brake systems.

- The *service brake* system applies and releases the brakes when you depress the brake pedal during normal driving operations.
- The *parking brake* system applies and releases the parking brakes when you use the parking brake control.
- The *emergency brake* system uses parts of the service and the parking brake systems to stop the vehicle in the event of a brake system failure.

There are many components of the air brake systems. The following are some parts of the system:

Air compressor – The air compressor pumps air into the air storage tanks. The compressor is connected to the engine through gears or a V-line belt. The compressor may be air or oil cooled.

Air Compressor Governor – The governor controls when the air compressor will pump air into the air storage tanks. When the air tank pressure rises to a preset level (around 125 psi) the governor stops the compressor. When the tank pressure falls below a preset level (around 100 psi) the governor allows the compressor to start pumping again.

Air Storage Tank – Air storage tanks are used to hold the compressed air. The number and the size of the tank(s) depend on the size of the vehicle. The tanks will hold enough air for the brakes to be used several times if the compressor fails to work. Compressed air usually has some moisture in it, which is bad for the air brake system. The water can freeze up in cold temperatures and make the brake system fail. The moisture tends to collect at the bottom of the air storage tanks. To ensure the moisture is removed from the tanks; each is equipped with a method of *bleeding* the tank. There is a manual method, which is done by either turning a stopcock valve located at the bottom of the tank allowing the air and moisture to be removed, or by pulling on a cable attached to a bleed off valve located at the bottom of the tank allowing the air and moisture to be removed. ****NOTE**** It is important to remember that once the tanks have been bled the system must be recharges prior to moving the vehicle. In some vehicles there is an *automatic bleed and dryer*. The automatic system responds by bleeding small amounts of air during normal operations. This has little impact on the operation of the brakes but does remove the moisture from the system. In addition there is a dryer attached to the system, which heats the air to keep the moisture level down in the system.

Safety Valve – A safety valve is installed in the first air tank the air compressor pumps air to. This valve protects the tank and the rest of the system from being over pressurized. This valve is usually set to release at 150 psi. ****NOTE**** If this safety valve releases air there is a problem that a mechanic should be notified immediately.

Brake Pedal – To apply the brakes you press down on the brake pedal. Pushing the pedal down harder applies more air pressure. Letting up on the brake pedal reduces the air pressure and releases the brakes. Releasing the brakes lets some of the compressed air to go out of the system, so the air pressure in the tanks is reduced. Pressing and releasing the pedal unnecessarily can let air out faster than the compressor can replace it. If the pressure gets too low the brakes will not work.

Foundation Brakes – Foundation brakes are used at each wheel. The most common type is the S-cam drum brake. The following is the break down of the brake parts:

- **Brake drums, shoes, and linings** – Brake drums are located on each end of the vehicle's axles. The wheels are bolted to the drums and the braking mechanism is inside the drum. To stop, the brake shoes and linings are pushed against the inside of the drum. This causes friction, which slows the vehicle (and creates heat). The heat a drum can take without damage depends on how hard and how long the brakes are used. Too much heat can make the brakes stop working.
- **S-cam Brakes** – When you push the brake pedal, air is let into each brake chamber. Air pressure pushes the rod out, moving the slack adjuster, thus twisting the brake camshaft. This turns the S-cam (named because of its S design). The S-cam forces the brake shoes away from one another and presses them against the inside of the brake drum. When you release the brake pedal, the S-cam rotates back and a spring pulls the brake shoes away from the drum, letting the wheels roll freely again.
- **Wedge Brakes** – In this type of brake, the brake chamber push rod pushes a wedge directly between the ends of the two brake shoes. This shoves them apart and against the inside of the brake drum. Wedge brakes may have a single brake chamber, or two brake chambers, pushing wedges in at both ends of the brake shoes. Wedge type brakes may be self-adjusting or may require manual adjustment.
- **Disc Brakes** – In air-operated disc brakes, air pressure acts on a brake chamber and slack adjuster, like S-cam brakes. But instead of the S-cam, a "power screw" is used. The pressure of the brake chamber on the slack adjuster turns the power screw. The power screw clamps the disc or rotor between the brake lining pads of a caliper, similar to a large C-clamp.

Supply Pressure Gauge(s) – All air-brake vehicles have a pressure gauge connected to the air tank. If the vehicle has a dual air brake system, there will be a gauge for each half of the system. (Or a single gauge with two needles). These gauges let you know how much pressure is in the tanks.

Low Air Pressure Warning – A low pressure warning signal is required on all vehicles with air brakes. A warning signal you can see must come on before the air pressure in the air tanks falls below 60 psi. The warning is usually a red light and on some vehicles a warning buzzer sounds as well.

Stop Light Switch – Drivers behind you must be warned when you put your brakes on. The air brake system does this with an electric switch that works by air pressure. The switch turns on the brake lights when you are applying the brakes.

Spring Brakes – All vehicles must be equipped with emergency brakes and parking brakes. They must be held on by mechanical force (because air pressure may leak out). Spring brakes are used to meet these needs. When driving powerful springs are held back by air pressure. If the air pressure is removed, the springs put on the brakes. A parking brake control in the cab allows the driver to let the air out of the spring brakes. This lets the spring brakes on. A leak in the air brake system, which causes all the air to be lost, will also cause the springs to put on the brakes.

Parking Brake Controls – In most vehicles, you apply the parking brakes using a *diamond-shaped, yellow, pull-push control knob*. You pull the knob out to put the parking brakes on (spring brakes), and you push it in to release them. ****NOTE**** Never push the brake pedal down when the spring brakes are on. The combined forces of the springs and the air pressure could damage the brakes.

Apparatus equipped with air brakes use two methods for parking brakes. First is a driveline brake, which is an actual disc or drum that attaches to the drive shaft and is operated by cables or levers. The second type is a spring-activated brake atop a service brake chamber that automatically applies the brake when the air pressure drops below a preset pressure.

It is important to define what a *Dual Air Brake System* is. Most new vehicles use a dual air brake system for safety reasons. A dual air brake system has two separate air brake systems that use a single set of brake controls. Each system has its own tanks, hoses, and lines, etc. One system typically operates the regular brakes on the rear axle(s). The other system operates the regular brakes on the front axle. The first system is called the primary and the other called the secondary system.

Many vehicles are equipped with *Antilock Braking Systems (ABS)*. The purpose of the *ABS* is to permit the driver of the vehicle to stop the vehicle in the shortest possible distance while maintaining full control. By preventing the wheels from locking, *ABS* helps to improve control and stability. *ABS* allows steering during braking applications, and in most instances, reduces stopping distances, especially on wet, icy, or loose gravel surfaces. *ABS* use sensors at each of the wheels to send wheel speed information to a central computer. When the computer senses that a wheel is about to lock up, it automatically “pumps” the brakes on that wheel.

Due to the size and weight of today's apparatus, secondary or auxiliary braking systems have been added to increase the braking capabilities of the vehicles. Essentially there are three (3) types of auxiliary braking systems:

- Engine Brake
- Automatic Transmission Retarder
- Driveline Retarder

The *engine brake* is known as a compression brake. The brake mechanism uses the “compression” that the engine creates to slow the vehicle down. Essentially the system is allowing more new air into the cylinders of the engine causing it to work or bear down harder creating less horsepower and a force. The *engine brake* customarily comes with a selection switch allowing the driver to decide on the amount of work the braking system should do (2 cyl, 4 cyl, 6 cyl) or high or low. It should be noted that *engine brakes* on vehicles with automatic transmission are typically not effective below 20 miles per hour (mph) due to the low rpm's of the engine while operating at low speeds. ****NOTE**** Most manufacturers recommend the retarder be turned off during inclement weather or slippery road conditions.

The *automatic transmission retarder* is attached to the transmission either on either end of the transmission. The input retarder operates on the input end and the output retarder, which is the most prevalent on fire service apparatus, is attached to the output end of the transmission. The retarder system is self-contained and consists of a vaned rotor, which rotates in a vaned cavity. The rotor is splined to and driven by the output shaft. An external accumulator holds transmission fluid until the retarder is activated. When activated, the fluid in the accumulator is pressurized and directed into the retarder cavity. The interaction of fluid with the rotating and stationary vanes causes the retarder rotor speed, and hence the output shaft, to decrease and slow the vehicle. ****NOTE**** Most manufacturers recommend the retarder be turned off during inclement weather or slippery road conditions.

The *driveline retarder* can be divided into 2 types, hydraulic and electromagnetic. Both types are attached to the driveshaft between the transmission and the rear axle. The hydraulic type absorbs energy by pumping oil around the driveshaft slowing the vehicle down. The electromagnetic retarder sets up a magnetic field that grabs the driveline. The absorbed energy is transferred to the surrounding atmosphere as heat. ****NOTE**** Most manufacturers recommend the retarder be turned off during inclement weather or slippery road conditions.

EXHAUST SYSTEMS

The exhaust system is basic and is comprised of a muffler or mufflers, exhaust pipes, tail pipes, and or vertical stacks. It is important to note that a faulty exhaust system affects the performance of the motor and can emit poisonous fumes into the crew area causing serious illness.

DRIVELINE

The driveline consists of the transmission, front universal joint, driveshaft, rear universal joint, differential, and the rear axle. The transmission is a system of gears that allows change in the ratio of the number of engine revolutions to the number of wheel revolutions. The drive shaft connects to the rear of the transmission and is powered to turn the differential. The differential is a component of the rear axle that the rear wheels are attached to. The entire system works in unison to rotate the rear wheels.

There are two types of transmissions: standard and automatic. The standard or manual transmission uses a clutch assembly to shift the transmission gears depending on the RPMs of the motor and the desired speed requested. Computer modules control the automatic transmissions. The modules signal and influence the engines RPMs during transitional shifting.

STEERING SYSTEM

The steering wheel and column connect to steer the vehicle. They connect to a gear and linkage mechanism that changes the direction of the front wheels. In most vehicles this either "power assist" or "power steering" to ease the turning of the steering wheel. These are both hydraulic (fluid) driven systems.

ELECTRICAL SYSTEMS

The electrical system supplies power for primary and auxiliary functions. The primary functions of the electrical system include: power the generator and storage battery, generator/alternator, and voltage regulators; power distribution (via engine wiring); timing (distributor); and spark generation if equipped. Auxiliary functions include: inside/outside lighting (headlights; amber, red signaling or warning lights; turn signals; instrument panel lights; etc.); and horn, siren, and public address system.

SUSPENSION

This system is comprised of leaf springs, shock absorbers/coils, air rides, and wheels, and tires that enable the driver to handle the vehicle properly on rough terrain and sharp curves.

WHEELS AND TIRES

As mentioned before the wheels and tires are a part of the suspension system; however, it's important to define them a bit more. Both wheels and tires must have a weight rating which will accommodate the weight distributed through the axle and springs. The condition of the tires is based on inflation, tread design, and tread wear. All of these have a major impact on vehicle handling. Each tire has only about 40 square inches of contact with the road. It is imperative that both the inflation pressure and tread be in good condition to provide maximum safety. The minimum recommended tread depth for emergency vehicles is 4/32 inches.

EMERGENCY VEHICLE PRE-RESPONSE PREVENTITIVE INSPECTIONS

Emergency vehicles of all types should be inspected prior to and again within 24 hours after being used for an emergency response. Emergency vehicle accidents caused by the lack of maintenance or vehicle malfunction are preventable. Physical and visual inspections must be done on a routine basis. In the final analysis, no matter who performs the actual maintenance on the vehicle, it's the driver's responsibility to confirm the vehicle has been inspected prior to use. The driver *must* verify that the vehicle is in proper operating condition. The responsibility for the mechanical safety of the vehicle is that of the driver. *IF IT ISN'T RIGHT, DON'T DRIVE IT.* The purpose of the pre-response preventive maintenance inspection is two fold – identify and correct unsafe conditions.

Inspection guidelines are broken down into nine (9) core areas to expedite the inspection process.

- Check prior maintenance records
- Conduct a vehicle overview
- Conduct an engine compartment check
- Conduct an interior cab check
- Conduct a vehicle walk around check
- Conduct a compartment and equipment check
- Conduct an undercarriage check
- Conduct a moving and driving test
- Complete inspection process

All inspections, maintenance, and repairs must be recorded by the Department. The records must include the date and description of all maintenance, repairs, and inspections performed. The following is a break down of the nine categories listed above:

Check PM Records - Each day the records of the previous days should be reviewed for defects and repairs.

Vehicle Overview – Conduct a vehicle overview including inspecting for body damage and cleanliness; and leveling of the vehicle (indicates suspension problems).

Engine Compartment – Conduct an engine compartment check with the engine off. You should check the following:

- Oil levels
- Coolant levels
- Power steering fluid level
- Transmission fluid level
- Air compression belts
- Hydraulic reservoir
- Brake fluid level
- Battery fluids both left and right
- Windshield washer fluid levels
- Belts and wiring harnesses
- Steering box not leaking
- Safety devices including hood latches and safety bars for tilt cabs

Interior Cab – Conduct an interior cab check by first properly preparing for the vehicle inspection:

- Engage the parking brake, chock the wheels, turn the batteries on, turn on the ignition master, place gears in neutral, and start the engine.
- Check the instrument/dash gauges for operating voltages, temperatures, pressures, and levels.
- Check the accelerator pedal padding, in place and not loose.
- Engage and disengage emergency air brake system.
- Conduct air/hydraulic brake test and listen for oblivious leaks, and/or blown diaphragms.
- Check steering wheel and column for centering, excessive play (greater than 10 degrees), and abnormal movement.
- Check electric/air horns for equal tone quality from each horn and blown diaphragm for moisture or oil on the windshield of the horn.
- Check electronic and mechanical sirens for excessive draw on ammeter and voltage fluctuations and electrical system problems.
- Check windshield wipers and washers as well as heating and defrosting systems.
- Transmission controls, such as the clutch catch or friction point, should be checked to ensure there is no hang up or binding and that it does not jump out of gear.
- Check radio equipment including fixed, portable, public address system, and cellular phone.
- Interior lighting systems in the cab and crew compartments should be checked to ensure they are working properly.
- Mechanisms for the seat adjustment, both mechanical and pneumatic, should be checked to ensure they are working properly.
- Check seatbelt (occupant restraints) systems.
- Check the interaxle differential locking systems, both dual and tandem axle.
- Check warning lights and buzzers systems, including oil, water, and transmission fluid level and temperature and open door compartment warning lights.
- Ensure outside mirrors, both manual and mechanical, can be adjusted and the wiring for the heating system is intact and operational.
- There should be the appropriate maps and accountability rings/systems on board.
- Internal communication devices and equipment (David Clark Systems) should be checked.
- Check the fast idle RPMs to ensure that it can maintain the electrical system.
- Check emergency lighting.

Vehicle Walk Around – Conduct a vehicle walk around and operate and/or check the following:

- Windshield and windows for any cracks that may necessitate taking the vehicle out of service.
- Check headlights, both low and high beams and four way flashers.
- Check the strobe lights and all the emergency vehicle-warning lights.
- Light bars, rotating lights, and/or oscillating lights should be checked.
- Check side markers and reflectors.
- Check turn signals.
- With assistance, check to make sure all the brake lights are operational.
- Check the generator(s) and or auxiliary power devices.
- Check flood light systems.
- Inspect PTO levers/switches.
- Check electrical and mechanical throttle assemblies and extend the outriggers to the maximum positions.
- Check levers and knob controls on all panels.
- On the tires and wheels, check for obvious gouges, slashes, cuts, bubbles, or any other damage. Make sure they are the proper size and are not mismatched. Look for indications of rust or peeling paint on non-aluminum rims. Check the condition of the lug nuts and wheel hubs. Check for any grease leaks. Inspect the rims for damage and missing weights. Make sure the tire pressure is correct and the valve stems are intact with caps. The depth of the tread should be 4/32" in the front and 2/32" in the rear.
- Check the auto chain systems for the rear wheel to make sure they function properly.
- The undercarriage should be checked for any obvious fluid leaks in the engine area (note the color of the fluid leaking).

Compartment Check – Conduct the compartment and equipment check:

- Make sure the compartment latching mechanisms work properly.
- Ensure the power equipment (gasoline or diesel) on board is working properly.
- Compartment equipment must match the inventory and are in its proper place.
- Make sure the circuit breakers are working properly.
- Ensure there are sufficient warning devices such as cones, flares, and reflective triangles on board.
- An assortment of fire extinguishers is on board and fully charged.

- Check for appropriate documentation (accident reports, vehicle registration etc.)
- Crew equipment should include SCBA, hand lights, AED, EMS, as the basic, should be checked to ensure they are in working order.
- Ensure all other equipment (haz-mat lights, etc.) is working properly.

Undercarriage – Conduct an undercarriage check:

- On the undercarriage bleed the moisture from the air tanks as required to check the color of the fluid being emitted – light gray sludge indicates a bad compressor: leaks from system ****NOTE**** Moisture should be bled from tanks frequently during inclement weather and temperature fluctuations. The brake lines should be checked for cracks, fraying, dry rot, pulling or distortion, or wear marks. ****NOTE**** Check slack adjusters for excessive movement, not more than 1 inch, and whether they are frozen in place. Do not attempt to make slack adjustments; trained personnel should conduct the adjustments.
- The driveline (engine to differential/rear axle) should be properly greased, make sure there is no excessive movement in the joints, and the dust covers are intact.
- Check the exhaust system for soot, black smoke, clamps and hangers, and any pitting on the underside.
- On the suspension system, mechanical or pneumatic, check the leaf springs for cracks and breaks, shackles and hangers, shock towers, and leaks and air leaks (shocks or bags).
- Make sure the automatic chain systems are securely attached and lined up properly.
- Look for obvious damage, such as rust, loose parts, shiny spots, asymmetrical parts (out of alignment), any cracks in the frame rails, and shifting body mounts.
- The inner sides of wheels and tires/ sidewalls on the tires should be checked for excessive dusting, fluid leaks, bad seals, and cracked brake drums and shoes.
- The wiring harness should be checked for frayed or cut wire.
- Check the fuel tank for obvious leaks that straps and grounding pad are intact, fuel lines are ok, and the overflow is not kinked.
- Check for leaks of any fluids and if there is, their point of origin, either the transmission, rear end, or plugs, vents or right side or rear axle. Do not paint over any of these areas.

Brake Test/Air Brakes - Conduct a DOT Brake Test. Note: this test is **ONLY** to be used on apparatus with air brakes. This test is **NOT** to be used on EMS units. Further information can be found on the MCFRS Quicklinks web page.

This brake test must be performed in the order shown below:

1. Chock the wheels of the vehicle.
2. Turn the ignition on and verify that all gauges/warning devices are in working order.
3. Air brake protection valve should be in the Applied (out) position. This takes the air out of the system and allows the spring brakes to hold the rear brakes.
4. Push air brake protection valve into the off position (in). This charges the air brake system.
5. Allow the air tanks to settle.
6. Observe the air gauge for one minute; look for air loss no greater than 3psi in that one minute.
7. After one minute has elapsed, place your foot on the brake pedal and apply a steady, holding pressure. Continue to hold steady pressure for one minute after air tanks settle.
8. Observe the air gauge during that minute, look for air loss no greater than 3psi.
9. Begin "fanning" the brakes. As air tanks deplete and the gauge reaches 90psi, you should get a low air warning light and buzzer.
10. Continue to "fan" the brakes. **NEVER FAN YOUR BRAKES WITH THE PARKING BRAKE APPLIED!**
11. At approximately 20-40psi on your air gauge, the air protection valve should activate. Continue "fanning" the brakes until this occurs.
12. If the valve does not activate, the apparatus fails the test. The unit should be placed Out of Service.
13. If the protection valve activates, stop "fanning" the brakes.
14. Start the engine and monitor the air pressure gauge. The air pressure **MUST** return to 120psi within 90 seconds at 1200rpm.
15. Check all gauges for working pressures, shut down engine, remove wheel chock and place unit back in service.
16. MCFRS Air Brake Test - Use the acronym: **COLA**
 - C** = Cut In Pressure-A Cut In Pressure will be approximately 100psi. Any compressor that does not cut in before 95psi must be reported to the shop immediately.
 - O** = Cut Out Pressure-Cut Out Pressure will be between 120-135psi. Any higher than 135psi must be reported to the shop immediately.

L = Low Pressure Warning-Low Pressure devices will activate at approximately 90psi. Any device that activates below 60psi must be reported to the shop immediately.

A = Air Leakage-with foot on or off the brake pedal, air leakage should be less than 3psi per minute (4psi per minute for a Tiller Truck).

Complete Inspection Process – Document the pre-response inspection and compare it to the previous report. Follow-up on discrepancies noted. If discrepancies are noted that influence on function, operational/directional ability, and/or safety, place the unit out-of-service and consult with the appropriate maintenance personnel before placing the unit back in service for responses.

ROUTINE MAINTENANCE ON EMERGENCY VEHICLES

Operator safety is dependant on the vehicle condition. Well-maintained vehicles have fewer malfunctions and are easier to control. The Department must identify the role of the emergency driver in the inspection and maintenance program. Routine maintenance of the vehicle is the responsibility of the driver. The Department should maintain checklists for these types of inspections and routine maintenance functions. Deficiencies should be repaired or reported in writing to the individual responsible for the maintenance. The role of the emergency driver as it pertains to preventive and routine maintenance is defined in NFPA Standard 1002, Fire Department Vehicle Driver/Operator Professional Standards. Applicable, with minor adjustments, to all emergency vehicles the standards states:

“... Prior to operating fire department vehicles the fire apparatus operator **shall** meet the job performance requirements as defined in ...”

As this relates to the preventative maintenance function, it specifically states that the driver shall be able to “perform routine tests, inspections, and servicing functions on the specified systems and components and ... so that the operational status of the vehicle is verified.”

The systems and components identified in NFPA 1002 are listed here. Items for consideration under each are identified as reference:

Battery(ies):

- Correct fluid levels (distilled water should be used whenever possible to maintain the proper water levels in the battery (ies))
- Connections of the cables are clean and tight
- Battery (ies) box/compartments are clean and secure

Braking System:

- Pressure prior to starting the engine (air) should be approximately 125 psi
- Build-up time, if appropriate (air), when the engine is operating at normal RPMs, the pressure should build from 85 psi to 100 psi within 45 seconds in dual air systems. In single air systems, pressure should build up from 50 to 90 psi within 3 minutes when operating at normal RPMs.
- ABS verification (dash light)
- Braking Operation (during runs as well as at inspection time)
- Brake pedal (proper range of motion)
- Moisture in system/drain air tanks, in tanks with manual bleed valves, turn the valve ¼ turn to drain air, moisture, and dirt from system. Return valve to closed position to build up air in system again

Coolant System:

- Correct level (generally approximately 2 inches below the top of the radiator, check with local requirements)
- Hose and/or connections wear/leaks

Electrical System:

- Ensure all lights and audio equipment is operational, if bulbs need to be replaced make sure the correct bulb size and style is used and replace faulty fuse in audio system if needed.
- Voltmeter should be reading between 12 and 14 volts

Fuel:

- Correct level, if not, fill tank with proper type of fuel
- Check any power equipment levels and fill as needed with the proper fuel for that equipment

Hydraulic Fluids:

- Check for leaks on the floor under the vehicle and areas around connections of the hoses
- Ensure proper levels and add (if permissible) with the appropriate type of fluid

Lubrication:

- Check for leaks on the floor of grease droppings
- Ensure there is not grease thrown in the engine compartment or body
- Use grease gun to fill "zirc" fittings when dry or on scheduled maintenance ****Note**** Do not overfill fittings or it will splatter

Oil (Engine):

- Leaks on the floor under the vehicle
- Proper levels checked using the dipstick in the engine compartment ****Note**** The engine oil should be checked when the engine is cool or cold, when the motor is warm or hot the oil is dispersed throughout the engine. To properly check the level the

oil should be allowed to settle back into the oil pan located at the bottom of the engine. This typically takes 20 to 30 minutes after the engine is shut down

- The color and texture of the oil on the dipstick should be noted. If the oil is frothy (bubbly) or a color other than dark brown or black, it should be investigated

Tires:

- Condition (sidewalls, rims, tread)
- Correct inflation pressure, fill as needed to the rated pressure for that tire

Steering System:

- Ease of operation (power OK and no extra play)
- Correct fluid level, this may be checked while the engine is hot or cold and the fluid level should correspond to that on the dipstick

SAFETY CHECKS AND ADJUSTMENTS MADE BEFORE DRIVING

There are certain items that should be checked by the driver prior to moving the vehicle:

Occupant Restraint Systems – Restraints reduce the likelihood of serious injury or death in the event of an accident. The law requires that there be a restraint for all riders and that they be used any and all times the vehicle is in motion. The restraints keep the driver in position behind the wheel and in front of the controls during sharp turns, over excessive maneuvers, roll overs, and yaw skidding or spins.

Adjustable Head Restraints – Head restraints help prevent cervical spine and other injuries from hyperextension and hyperflexion; ie. forces resulting from rear end collisions. The proper adjustment for the head restraints is to have the center of the restraint at the center of the skull not at the base of the neck. If the restraint is too low, the neck could be broken if force of impact is great.

Seat Position – When the seat is properly adjusted, the brake and accelerator can be applied fully without fully extending the leg. The steering can be held with only a slight bend at the elbows. The seat should be fully locked into position. If the seat was to move during operation, it could cause the driver to lose control.

Mirrors – Check for proper adjustment of the inside mirror if applicable. This mirror is used to watch personnel if need be. The outside, side-view mirror should have the edge of the vehicle's rear fender and side lanes visible. Convex mirrors assist drivers by providing wide-angle views of traffic on either side of the vehicle. In all vehicles the most dangerous blind spots are by the rear quarter panels. In larger vehicles there are generally blind spots below the mirrors.

PRECAUTIONS BEFORE MOVING

The safety of the entire crew pertaining to the vehicle movement is that of the driver. Prior to moving the vehicle an audible signal from all crewmembers that they are belted and ready should be heard by the driver. Only one person (besides the driver) should be in the front seat or control cab. Prior to moving, ensure the station doors are opened, all compartments and cab doors are closed, and there are no obstacles in the path of the vehicle. If responding, ensure that all emergency lights and audible warning devices are on and sounding. Taking these precautions will provide a safe operation of the vehicle.

OPERATING AN EMERGENCY VEHICLE

Purpose of Emergency Vehicle Signaling Equipment

Lights and sirens (Emergency Vehicle Signaling Devices) are used to inform traffic, both vehicular and pedestrian, of an emergency vehicle presence and aids in clearing a path for the emergency vehicle. Warning and signaling equipment assist the operator with arriving at an incident safely. Due regard **MUST** always be exercised, regardless of the seriousness of the emergency.

Local Law (Maryland)

Maryland law requires an emergency vehicle operator to activate and use emergency warning and signaling devices while responding to a "bonafide" emergency call. In return for this, emergency vehicle operators are granted "qualified privilege" with regard to basic rules of the road. To respond to an emergency call, and be covered as an emergency vehicle under statute or law, the emergency vehicle operator must display all appropriate audible and visual warning and signaling devices. Responses to incidents are either emergency or non-emergency. If the operator decides to take advantage of "qualified privilege", full use of audible and visual devices must be used. You can't be selective. It is important to remember use of signaling equipment by the operator **DOES NOT** guarantee operator safety, nor does it free the driver from the possibility of civil or criminal liability if a mishap does occur.

To better understand the liability and responsibility of the driver, a few definitions will be discussed. They are as follows:

- **True Emergency** – is defined as a situation in which there is a high probability of death or serious injury to an individual or significant property loss.
- **Due Regard** – for the safety of others means that a reasonably careful person performing similar duties under similar circumstances would act in the same manner.
- **Negligence** – A legal deficiency or wrong that results whenever a person fails to exercise that degree of care that a prudent person would exercise under similar circumstances.
- **Gross Negligence** – Is the reckless disregard of the consequences of an act to another person. It occurs when a person's actions (or lack of) result in the failure to exercise even a slight degree of care.
- **Willful and Wanton** – Intentional or with careless indifference (considered the most serious form of negligence).
- **Vicarious Liability** – The legal liability placed on one person for the acts committed by another person.

Usually a court will judge the actions of an emergency vehicle driver based on two primary considerations: First, was the emergency vehicle responding to a **true emergency**? Second, did the emergency vehicle driver exercise **due regard for the safety of others**? If the answer to both questions is yes, the emergency driver has demonstrated a responsible and professional attitude through his/her subsequent action(s).

Using Emergency Vehicle Signaling Equipment

An emergency vehicle driver should use all signaling devices when responding. Remember that most emergency vehicles are taller than the average automobile on the road. You, as a driver should use all means to gain the attention of the vehicles in front of you. When approaching a vehicle from the rear at night, flick the vehicle's high beams on and off to get the attention of the vehicle in front of you.

It's a good practice while responding to an emergency to leave the drivers' and officers' windows down at least partially. This will aid in hearing other responding apparatus, trains, and approaching traffic. Pay attention to the reaction of the other drivers. They, for the most part, are trying their best to move out of your way, however; they are reacting to your actions and not paying attention to the other vehicles on the road. **PAY ATTENTION!**

BASIC EMERGENCY VEHICLE CONTROL TASKS

Steering, accelerating, and braking accomplish directional and velocity control. A competent emergency vehicle driver understands and properly completes all of the basic driving maneuvers necessary to operate the emergency vehicle they are certified to operate.

Steering – Steering an emergency vehicle, whether driving non-emergency, responding to an emergency, or making an evasive maneuver, requires certain habits. These include:

- Use both hands on the steering wheel. Exception includes operating another device on the vehicle such as shifting or turning on the windshield wipers.
- Keep arms inside the vehicle. Do not engage in other activities such as drinking, eating, smoking, or talking on the phone while operating the vehicle.
- Maintain hands in the “3 and 9” position on the steering wheel.

Braking and Stopping – Effective braking is essential to the safe operation of an emergency vehicle. The intent is to stop the vehicle in as short a distance as possible while maintaining control. In a vehicle with hydraulic brakes, this involves firmly pumping on the brake pedal and releasing it prior to the locking of the wheels. Air brakes require firm and steady pressure without pumping. To have effective braking on a vehicle with anti-lock braking system (ABS), whether installed in conjunction with a hydraulic or an air system, you must follow the procedures below:

- On vehicles equipped with air brakes, the brake pedal should be initially firmly pressed. The driver must ease up as the braking continues, and ease the pressure on the brake pedal just before stopping to avoid a jerking action.
- If the vehicle's wheels lock, immediately release the brake pedal and steer with the skid. Reapply the brakes when control has been established.
- It is important to recognize the continuous braking over a period of time builds up a tremendous amount of heat. This could cause glazing of the brakes that greatly reduces the braking capacity of the system and could cause brake failure.
- On vehicles equipped with a secondary braking system, apply the system in accordance with the manufacturer's recommendations. Recognize that some applications of secondary braking systems can cause a reduction in tire traction.
- In areas where there is a high probability of braking, passing through an intersection or traveling against traffic; the driver should place their foot over (cover) the brake pedal. This action will reduce the reaction time.

Backing – Backing mishaps account for a large portion of emergency vehicle accidents. Most backing accidents are relatively minor, however, they can have a wide range of consequences. Accidents keep emergency vehicles out of service for repairs; they cause the operator a lot of paperwork and time, and cost the taxpayers money. These accidents also create a bad public image.

Techniques to minimize backing accidents require common sense. Take a few extra seconds to ensure safety in backing. Plan ahead. Some guidelines for backing an emergency vehicle include:

- Park so as to minimize the need for backing - If thought is given to the position necessary for a vehicle leaving its location, a simple adjustment in the final placement can minimize or even eliminate the need for backing.
- Give audible notice – If the vehicle is equipped with a back-up alarm, shift the vehicle into reverse while applying the brakes. This will initiate most back-up alarms. If the vehicle is not equipped with an alarm, touch the horn lightly 3 times before beginning the backing maneuver.
- Use a spotter – The spotter is to be located at the rear and left of the vehicle. Remember, the driver must be able to see the spotter and vice versa. The driver and the spotter must make mutual eye contact. If the spotter disappears from the mirror, the driver must stop immediately. *IF* a spotter is absolutely unavailable, conduct a walk around the vehicle before backing.
- Understand hand and audible signals – Ensure that the driver and spotter have the same understanding of what the signals mean.
- Use side mirrors – The driver should not attempt to lean out the window or turn around trying to see. Periodically check the right side mirror for objects in the path of the vehicle.
- Check the front corners – Either the right or left front of the vehicle may swing around and strike a fixed object that did not initially appear to be a potential problem.
- Maintain speed control – Backing should be done at an extremely slow speed. It is imperative to maintain tight control on the speed of the emergency vehicle.

The bottom line is this – when you strike something while in reverse and you do not have a spotter in place, you don't have any excuse! If it's predictable it's preventable. There are no excuses for backing accidents when spotters are available.

Parking – Good parking skills are essential. Parking is a basic control task, but requires many driving skills. When it is performed under stress, it can be difficult and time consuming. Parking in the emergency mode must be done quickly. It requires skill to do it fast and without mishap. Parking generally consists of three types – angular, perpendicular, and parallel. On an incident any one or all of

these skills may be used to properly place the vehicle. Some factors to take into account when positioning an emergency vehicle are as follows:

- Position emergency vehicles at incidents so as to minimize the blinding effect of warning lights on approaching and passing vehicles.
- Identify potential hazards at the incident and the possibility of escalation.
- Identify appropriate safe distances for certain type of emergencies.
- Consider the ease of leaving the scene because of changing conditions at the emergency incident or a directive to either leave the scene and respond to another incident or be available for another potential incident.

URBAN DRIVING SKILLS

Even in normal, non-emergency conditions, operating an emergency vehicle in urban areas requires a high degree of skill. Emergency vehicle operator must present good examples to other motorists and pedestrians. The key to successful urban driving includes keeping alert for pedestrians, alleys and cross walks. Anticipate other motorist's actions – expect the unexpected! Always make an eye contact with other motorists to anticipate and communicate movement and/or intentions. If they don't see you, they can't transmit or communicate their intentions.

When driving in urban areas in an emergency mode, your speeds in excess of a posted limit are rarely justified. Excess speed should only be used in extreme cases and **ONLY** if the road conditions permit it. Reasonable speeds allow more time to react and more opportunity to control the emergency vehicle if an evasive action is required.

Urban driving in an emergency mode requires effective use of lights and sirens in order to warn motorists and pedestrians of the approaching emergency vehicle and to clear traffic and/or help the operator negotiate through heavy or blocked traffic. The typical motorist's reactions to lights and sirens will generally be to try to pull to the right and slow down or stop when they detect and approaching emergency vehicle. Some motorists, however, will do senseless, unexpected things. Some of the possibilities are: stopping in the middle of a lane, blocking the emergency vehicles forward progress, trying to compete (race) with the responding vehicle, or beat the emergency vehicle to and/or through an intersection. In some cases they do nothing at all and just keep traveling. Contributing factors to this could be that the radio or air conditioner is on and/or failure of the driver to check the rear-view mirror.

Backing off the siren and giving the other driver a chance to think and react is the best way to handle confused motorists. Tap the horn or flash the vehicles lights to try to establish eye contact. When following an automobile, beware of startling an unsuspecting motorist. They could respond hazardously.

Vary the siren pitch and duration; use headlights, horn, siren, or spot light to get their attention. Be patient, keep signaling. Try and avoid passing on the right, unless it's the only way. Do not cross double solid lines to pass or avoid stopped traffic. The law does not allow for this and if the emergency vehicle collides with oncoming traffic, the emergency vehicle driver will be held accountable.

Traffic blockages are unavoidable, particularly during rush hour. In these situations route planning, including alternate rush hour routes is essential. If traffic is blocked, slow down before reaching the blockage. This will give the emergency vehicle operator a better view and make it easier to detect what effect the signaling equipment is having on the other motorists. Use the siren intermittently and be patient. If traffic is unable to move, it does no good to keep the siren wailing constantly. Everyone involved is likely to become irritable and impatient.

NEGOTIATING INTERSECTIONS

Intersections are the most accident likely areas. There are two types of intersections: an *uncontrolled intersection* is any intersection that does not offer a control device (stop sign, yield sign, or traffic signal) in the direction of travel of the emergency vehicle; or when a traffic signal is in the green mode for the emergency vehicle. A *controlled intersection* is defined as any intersection that the vehicle must stop at, including stop signs and traffic signals. Some things to keep in mind for each are:

Uncontrolled

- Scan the intersection for possible hazards (right turn on red, pedestrians, vehicles traveling very fast, etc.). Observe traffic in all four directions.
- Slow down and cover the brake pedal with your foot.
- Change the siren cadence not less than 200 feet from the intersection.
- Avoid using the opposing lane of traffic, if at all possible.

Controlled

- Do not rely on warning devices to clear traffic.
- Scan the intersection for possible hazards as well as alternatives.
- Begin to slow down well before reaching the intersection and cover the brake with your foot.
- Change the siren cadence not less than 200 feet from the intersection.
- Scan the intersection for possible passing options (pass on the right, left, wait, etc.). Avoid using the opposing lane of traffic, if at all possible.
- Come to a **complete stop**.
- Establish eye contact with other vehicle drivers; have partner communicate all is clear; reconfirm all other vehicles are stopped.
- Proceed one lane of traffic at a time. Treat each lane of traffic as a separate intersection.

Some techniques best used for intersections are basic but can prevent many accidents. Before crossing an intersection, the vehicle operator must make sure there is an adequate gap in traffic. From a full stop a small vehicle needs about four to seven seconds to cross an intersection 30 feet wide (two lanes). For larger vehicles, the time increases according to size, accelerative capability, etc. Cars approaching from either direction should be at least six seconds from the intersection. The vehicle operator should look left, then right, then left and straight ahead before crossing an intersection. When making a right turn at an intersection from a stop it takes about six seconds to turn right and accelerate to a speed of 30 mph. This time increases with the size of the vehicle. When the driver begins the turn, any vehicle approaching the intersection from the left should be at least eight seconds away from the intersection. This will allow the approaching vehicle two seconds of space between the two vehicles. Left turns at intersection require a larger gap than right turns because of the need to cross traffic lanes. Ten seconds is the minimum safe time needed.

When moving through an intersection while responding on an emergency, the vehicle operator should provide as much information as possible to other motorists. Use all means of signaling – lights, sirens, turn signals, lane position, and eye contact or hand signals. Signal the emergency vehicles intent at least one block in advance of an urban intersection and five seconds in the country. **Maryland law refers to 100' and 200'.** Check for traffic control indicators in advance of intersections, such as lane markings, signals, stop or yield signs, and crosswalks.

It's important to check for hazards well in advance of intersections. Make sure the vehicle operator's and officer's windows are partly open. This will enable detection of other emergency vehicles and traffic. Stay especially alert and search for actual hazards such as bad road surfaces and other motorists in the traffic lane, potential hazards like bicyclists or pedestrians, and finally for crossing traffic.

TURNING VEHICLES AROUND

Any type of turnabout can create a hazardous situation when performed on a street. Generally, the fastest way to turn around is to use reverse but remember to always use a spotter. In congested areas, going around the block may not only be safer, but also faster! Choosing a safe location to turnabout is important; choose an area with good visibility. You should have a clear view of the entire path of travel and all traffic lanes. Avoid hills, curves, and blind intersections.

The types of turnabouts, in order of increased hazard potential, include the U-turn, the two-point turn, and the three-point turn.

- The *U-turn* is the least hazardous type of turnabout. It is the easiest to perform but requires a wide roadway and good visibility.
- The *two-point turnabout* is made when the road is too narrow or restricted visibility won't permit a U-turn. The type of turnabout made depends on whether there is a side road or alley. The left side-road turnabout is more hazardous than the right. It should be a common practice not to use driveways to turnabout in because they may not support the weight of the larger emergency vehicles.
- The *three-point turnabout* is the most hazardous. It should only be used when the road is too narrow for a U-turn, there are not any alleys or side roads on either side, or if traffic is light.

In turnabouts in the emergency mode, if any exemptions are being exercised (e.g. U-turn where illegal) emergency-signaling equipment must be activated. The emergency mode may dictate performing more hazardous types of turnabouts. Always use regular signaling equipment, as well as emergency signaling devices.

SAFE FOLLOWING DISTANCES

A safe following distance means being able to stop safely without hitting the vehicle ahead if it stops suddenly. Rear-end collisions result from driver inattention to time and distance requirements. The law places the responsibility to maintain alertness and proper vehicle spacing on the following vehicle and its operator. If the proper distance is observed, left and right lateral evasive and other abrupt anti-collision maneuvering is minimized and unnecessary. Emergency vehicles are considerably larger in size, mass, and weight than smaller passenger conveyances, and require longer stopping distances when traveling at high speeds, especially during responses.

To accurately determine safe following distances, some factors need to be identified. First, *reaction distance* is the distance a vehicle travels from the time the driver perceives the need to stop until brake pedal movement begins. Average drivers require about $\frac{3}{4}$ to 1 second. Factors influencing reaction time are driver alertness and visual scanning. The driver's ability to perform under stress and the driver's experience are also factors that influence reaction distance. The distance traveled in $\frac{3}{4}$ to 1 second will be greater at higher speeds. Second, *braking distance* is the distance traveled from the first brake pedal movement until the vehicle comes to a full stop. There is no average braking distance. Vehicle speed, velocity, momentum, and inertia (higher speed = greater braking distance) as well as vehicle weight (heavier vehicles tend to require greater stopping distances) all affect the braking distance. Vehicle condition

(brakes, tire tread), road surfaces, and road conditions (wet, icy, rutted) are also factors that affect braking distance.

An appropriate following distance will allow enough time to come to a full stop if the lead vehicle panic stops. A safe way to determine following distance for an emergency vehicle is the four second rule. The four second rule keeps a separation of at least four seconds between the emergency vehicle and the vehicle being at 40mph. For each additional 10mph another 1 second is added to the time. In adverse weather conditions, add another 1 second per 10mph to the time. To begin the count, pick a stationary object and as soon as the vehicle in front as passed it start counting 1001, 1002, etc. You stop counting when your vehicle reaches the same marker.

Common sense must prevail in determining when to increase following distances. Time and spacing requirements are predicated on the speed and conditions the emergency vehicle is traveling and operating in. Traffic density or volume, road surface conditions, hazards, roadway design, and speed limits influence the following and stopping distances. When conditions get bad, add more distance. The larger and heavier the vehicle is, the harder it will be to stop, and the stopping distance will be greater.

PASSING ANOTHER VEHICLE

Often it is necessary for the emergency vehicle to pass other vehicles. At highway speeds (40 to 60 mph), a safe pass can be completed in about 10 seconds. The emergency vehicle will travel about 1/6 of a mile (825 feet) at 55 mph during that 10-second period. The rule of thumb for passing and visibility distance is:

Starting Speed	Passing Distance	Visibility Distance
30 mph	450 ft	900 ft
35 mph	525 ft	1050 ft
45 mph	675 ft	1350 ft
55 mph	825 ft	1650 ft
60 mph	900 ft	1800 ft

There are some considerations that should be taken into account before initiating passing. They are as follows:

- Is it necessary to pass under emergency / non-emergency conditions?
- Is there a pressing need to “get around” the vehicles ahead, or is it related to driver impatience?
- Will vehicle traffic ahead move to the right in response to your audible/visual warning devices, negating the need for passing?
- Can it be done safely?
- Does the vehicle being driven respond to increased power demands or does it react in a sluggish manner?

Road information is critical to successful passing. Look for informational signs (No Passing, Intersection Ahead, etc.), road markings (solid centerline, broken centerline, etc.), road configurations (hills, curves, intersecting roads, etc.). If “No Passing” is advised, there is a good reason, such as a hidden driveway, schools, damaged roads, or poor road design. A pass should never be made on a stretch of road where there are intersecting roads or driveways. Never pass a stopped car or line of cars without first finding out why they are stopped. Remember that many passing situations are potentially hazardous and involve some risk. Most motorists will attempt to pull over when confronted with a responding emergency vehicle. If the vehicle must pass the operator should do an evaluation of risk vs. benefit. In the emergency mode, the gain (saving a life) may justify increased risk. When conditions are ideal, there is a very little risk. In any situation avoiding mishaps is optimal. The following are some good tips to avoid mishaps when passing:

- If decision has been made to pass, and conditions are ok, DON'T HESITATE, conditions could deteriorate.
- Stay in the passing lane the shortest time possible.
- Constantly scan the roadway for unmarked, intersecting roadways.
- Be prepared to abort if conditions deteriorate. Most vehicles can slow up more rapidly than they can accelerate.
- Unless fully abreast of another vehicle, it is often safer to pull behind than to try accelerate.

EXPRESSWAY OPERATIONS

The term expressway includes interstates, freeways, turnpikes, or any other type of limited access multi-lane highway. Entering and exiting expressways are maneuvers that place a big demand on the operator to make fast, accurate decisions in rapid succession. Driving at or above the posted speed limit requires constant awareness of the road and traffic environment. Entering and exiting expressways is generally accomplished via “cloverleafs”. Cloverleaf intersections can be one of the most difficult things to accomplish

safely. One group of vehicles is slowing down to exit while another set is accelerating to enter. The two groups must cross in the right most lanes. Whether entering or exiting the cloverleaf, you should be prepared to stop in the event the vehicle in front of you stops suddenly. The most important things to remember when entering or exiting a cloverleaf are:

- Constantly use your mirrors.
- Always be prepared to stop suddenly.
- Look well in advance of your current position.
- Get in and out of the right most lane as quick as possible
- Adhere to ramp speed limits. They are generally on curves that can cause rollover.

Emergency operations on expressways are similar to rural roads with a few exceptions. Use of lights and sirens should be avoided on entrance ramps so that motorists won't become confused. Make a normal entry, assess traffic flow conditions, and choose a lane for an emergency run or high-speed operation before activating lights and sirens. Avoid weaving from one lane to another. Motorists may be unaware the vehicle is in the emergency mode if there is low sun or glare which may interfere with the emergency lights.

DRIVING AT HIGH SPEEDS

The practice of driving at speeds in excess of the posted limit is generally not recommended; however, if you chose to exceed the posted limits you should have already done a *risk vs. benefit analysis* and have chosen the need to exceed the posted limits. In all cases, there are some primary rules that should be adhered to:

- Negotiate a curve slower than what the yellow warning sign indicates is a safe speed for the curve.
- Observe posted speed limits.
- Allow for conditions that make a lower speed necessary, e.g., wet pavement, ice, traffic conditions etc.
- Avoid heavy or excessive braking action that may lead to brake fade.

In turns, centrifugal force quadruples as speed doubles. When the centrifugal force is high enough the vehicle cannot follow the curve on the intended track. For any curve, there is a maximum speed for traveling through the curve safely. The tighter the curve, the slower the vehicle must travel. If speed in a curve is too great, physics will win and the vehicle will become out of control. A properly designed curve should slant downward to the inside of the curve. Some older roads are banked the opposite way. Some are crowned in the middle. The operator should be as familiar as possible with the road design in their response areas. Road construction plays a role in the traction a vehicle

maintains in a curve. If the road is cracked and decaying the traction is reduced. The surface material (asphalt or concrete) is a factor. Vehicles don't have nearly as much traction on blacktop roads as they do on concrete. Bumpy roads reduce the amount of surface contact between the tires and road that will reduce traction in the curve.

Due to land availability or restrictions, designers often lay out curves in a decreasing radius pattern. This is a design by which the turns start out with a relatively large radius (curve) that tightens as the vehicle passes through the curve. On decrease radius curves, the maximum entry speed is too fast for the later (tighter) portion of the curve. If the speed is too high for the tighter portion of the curve, physics will win and vehicle control will be impossible. When approaching a decreasing radius curve, the driver should elect an appropriate entry speed for the entire curve. The speed cannot be selected, unless the road configuration is known in advance. Know the area!!! The entire curve must be considered before negotiating a curve. There are three points which are critical in negotiating curves; 1) Proper speed and vehicle position for entry to curve; 2) Maintaining control in the curve; and, 3) Proper speed and vehicle position for transitioning through the curve. To better define the safe mechanics of transitioning a curve, the following is a breakdown of a curve and proper techniques to pass through it.

Entry – Brake or decelerate to the proper entry speed *before* entering the curve. Enter the curve as far to the outside as possible. Entering on the outside of the curve effectively increases the radius of the track for the vehicle. The greater the radius, the faster the turn can be safely negotiated. Begin the turn as early as possible.

Transition – If the maximum safe speed to maintain control passing through a curve has been attained, the emergency vehicle operator experiences full control of the vehicle. The maximum “safe” speed is not the maximum “possible” speed that conditions will allow. When approaching maximum possible speeds, it will feel as though the suspension is straining. Do not apply aggressive braking. Allow natural friction of the engine and compression to slow the vehicle down. In a curve, vehicle control becomes so critical that a relatively small event (e.g. some sand or gravel on the road) can cause complete loss of control. Once in the curve, coast a speed to maintain traction and friction. Apply power carefully. TO much power can result in loss of steering control and cause the rear wheels to spin and lose rear end traction.

Exiting – Exiting curves require the vehicle operator to keep the vehicle's speed slow and steady. Maintain position on the inner surface of the curve. Exiting to a straightaway requires the operator to maintain lane positioning. Gently accelerate out of the curve after the apex has been reached and the vehicle is on a straight path.

It should be revisited that stopping at higher speeds require more stopping distance and is harder on the braking systems. Here are some basic techniques for stopping from a high speed:

- Laws of physics, particularly generation of heat in reducing speed, are operating on brakes.
- Overdo it and the physics will make the vehicles brakes useless. Don't abuse brakes; mechanical devices will fail.
- Be particularly cautious of long down hill grades. Use a lower gear to hold speed down rather than using the brakes. Select a gear before standing a descent.
- Proper high-speed braking techniques depend on the kind of brakes the emergency vehicle has. For either disc or drum brakes, it is not advisable to lock up the wheels. The stopping distance will be increased with locked wheels and the directional control will be lost.
- Use the right foot for braking. When a stop is imminent, "cover" the brake with the right foot. Don't risk brake fade by riding the brake.

HANDLING UNUSUAL AND DANGEROUS DRIVING SITUATIONS

Driving In Adverse Conditions

Civilian drivers usually choose when and under what conditions they drive. Unfortunately, the emergency vehicle driver must operate whenever an incident occurs. Many times this involves adverse conditions. Typically, adverse conditions can be classified in terms of:

- Traction Implications
- Adverse Handling Implications
- Vision Implications

If these adverse conditions cannot be adequately handled or if other unexpected situations occur, the emergency vehicle driver may need to initiate crash avoidance procedures. Emergency drivers must adjust their driving techniques for all adverse conditions. The driver's primary responsibility is the safety of the passengers and arriving safely at the incident. Slow down and drive at a speed reasonable and appropriate for the conditions. Increase following distances and drive smoothly with any vehicle to avoid sudden and dramatic maneuvering. Prioritize the response and use common sense!

Traction Implications – The traction of a vehicle is adversely affected by a variety of environmental conditions. These include rain, snow, ice, high winds and/or leaves on the roadway.

- Rain – In addition to oil buildup, water forms a layer that builds between the tires and the road surface. As little as 1/16th of water can cause hydroplaning of a vehicle. Standing water may also impact steering, braking, and general vehicle operation.
- Snow and Ice – Snow and ice form an extremely slippery road condition resulting in reduced traction for vehicle tires. Also, certain features such as bridges may experience snow or ice prior to the road surfaces.
- Leaves – In many areas large amounts of leaves accumulate on the road surface. They can result in slippery conditions equal to snow or ice when they become wet.

Whenever conditions have caused reduction in traction, the driver must reduce speed: and, steer, accelerate, or brake smoothly and evenly. The required stopping distances multiply depending on the condition of the road surface.

Adverse Handling Implications – Adverse handling could be caused by natural implications such as high winds, and trees or general ground terrain. Road construction and design or some man made implications. Again, reduce speed and maintain control of the vehicle.

Vision Implications – Conditions that affect the vision of the driver include night driving, precipitation, the vehicle, and the condition of the driver.

- Night Driving – Driving at night increases the potential for problems because of factors such as: hidden hazards; increased difficulty in judging the speed of other vehicles, and distance; limited highway lighting; and glare from roadside lights. Even with these limitations and possibly impaired vision, a few simple rules can help the driver compensate.
- Dim dash and cab lights.
- Reduce speed.
- Keep headlights and windshield clean.
- Watch area beyond headlights.
- Keep eyes moving and scan continuously.
- Precipitation – Rain, fog, and snow reduce visibility. In addition, rain and fog increase glare both during the day and at night. During the day when the sun is out, the snow on the ground creates a considerable glare as well. It is imperative that the vehicle be kept under strict speed control. Poor visibility conditions require the operator to:
 1. Drive slowly but keep moving.
 2. Turn headlights (low beams only) and wipers on.
 3. Use four way flashers if traveling 15 mph or more below the posted speed limit.
 4. Watch for cars ahead that are moving very slowly.
 5. Avoid decelerating suddenly.
 6. If you must pull off the road, use four way flashers.
 7. Do not pass.

8. Use the defroster or air conditioning to minimize fogging on the inside of the windows.

CONTINGENCY SITUATIONS – CAUSES AND PREVENTION

Contingency situations can arise at any time. A contingency situation is described as a possible future event, condition, or an unforeseen occurrence that may necessitate special measures. It is something that is liable to happen as chance as a chance feature or accompaniment of something else (Webster's Third New International Dictionary, 1993). When they arise, normal traffic flow may be suddenly interrupted and the safety of all persons in the general area is diminished. It is a good policy to be familiar with contingency situations that occur most often, and to understand the actions that can be taken to minimize the likelihood of death or injury. The five primary causes of contingency situations are:

1. *Vehicle malfunction of component failure* – There are a number of things the operator can do to prevent vehicle malfunctions or component failures. Inspect the vehicle at the beginning of every shift and correct any deficiencies noted at that time. Correction is the best prevention.
2. *A sudden change or deterioration in the road* – When there is a sudden change or deterioration in the road conditions (weather, damage, construction, etc.) remain alert, scan well ahead, and look for clues like construction signs or skid marks on the road.
3. *The appearance of an obstacle in the roadway* – Be prepared for an appearance of obstacles in the road (e.g. pedestrians, other vehicles, animals, etc.). Maintain a safe and controlled speed. Watch for obvious clues like children playing or bikes near the road.
4. *A sudden change in the weather* – Road conditions change very rapidly with precipitation. Look for icy patches and remember it takes very little water on the road surface to cause a sliding situation.
5. *Driver error, inattention, and inexperience* – Begin the shift well rested with no unusual physical or mental impairment. Remain alert, know the vehicle characteristics, avoid unnecessary risks, and most of all don't panic if change occurs.

HANDLING CONTINGENCY SITUATIONS

Since vehicle operators may spend many hours driving under unusual situations, it is probable that sooner or later an unusual situation will occur. The best way to minimize the impact is to be as prepared as possible and comfortable with the evasive maneuvers available.

Such actions as evasive steering, or sudden and extreme changes in the vehicles direction, are often used to avoid pedestrians, animals, vehicles, or other obstacles. These actions are usually done because it is too late to brake to a stop. The driver needs to weight the action vs. outcome of the contingency. Is it safer to collide with a small animal rather than risk losing control due to a sudden steering or braking maneuver?

The vehicle driver must scan ahead along the roadway; shoulders and/or median to identify any potential escape routes, which can be safely used to avoid a crash. Scan carefully when approaching the crest of a hill, rounding a curve, and when approaching intersections. These situations minimize possible escape routes.

Evasive steering is used to avoid a collision or minimize the impact of a collision. Hands should be at the 9 and 3 o'clock position on the steering wheel. This will allow the largest possible turn without moving the hands. The 10 and 2 o'clock positions are more comfortable, but the 9 and 3 o'clock position allows maximal directional control. To avoid a collision, turn the steering wheel sharply in the direction of the escape route and counter steer as soon as the vehicle is clear of the obstacle. When one is sure that a collision is unavoidable, choose an object with which to collide. Always choose the course least likely to result in a serious accident. Head-on collisions are the most damaging collisions. Attempt to sideswipe or brush another object. Impact absorbing objects are better to choose than large immobile items that will not "give". Some examples of impact absorbing objects are parked cars, bushes and shrubs, and small signs. Examples of nonimpact-absorbing objects include concrete abutments, buildings, large trees, and utility poles. All collisions are preventable and therefore avoidable. They occur when the vehicle operators aren't paying attention to the roadway dynamics, other vehicles, and/or the rules of the road.

Although sometimes it may be necessary to brake, hard braking should be avoided. Hard braking can lock the wheels; locked wheels won't steer. Rear wheels tend to lock before the front wheels. Locked rear wheels tend to seek the front (skid). Slow down and maintain control. With passenger vehicles very abrupt maneuvers are possible unless the wheels will hit the curb, a rut, etc. However, skidding, yawing, and other loss of control scenarios will occur if conditions arise. A large vehicles steering ratio usually precludes excessively abrupt maneuvers.

In addition to evasive steering, there are two other forms of maneuvering to avoid collisions – *emergency braking and evasive acceleration*.

- *Emergency braking* – The goal for emergency braking is to produce the shortest possible stopping distance without locking the wheels or losing control. The threshold braking method for accomplishing this is hard pressure to the brake pedal without locking the wheels. Modulate the

pressure on the pedal. Apply steady pressure to the point of locking, and then release pressure slightly to get rolling traction. If the wheels lock, **release the brake pedal**. A vehicle with ABS does not require threshold braking because the computer will not allow the brakes to lock up; a steady pressure should be maintained on the pedal. Remember that a rapid stop could cause a rear-end collision; however, this is more preferable than hitting a pedestrian. Remember the action vs. outcome formula.

- *Evasive acceleration* – Evasive acceleration means a quick burst of speed. It can be used to avoid collision with side approaching or merging vehicles. When a vehicle is approaching from the side or merging, increasing speed can often avoid a side impact collision.

HANDLING SKIDS

There are many reasons for skids; however, these are the primary ones:

- A too-sudden change of speed or direction.
- Any change of speed or direction under conditions of poor traction.
- Sudden shift in weight dynamics.
- Poor tire tread.
- Improper tire inflation.
- Driver inattention.
- Improper application of the braking system.

TO help regain control no matter what type of skid is occurring, **STAY OFF THE BRAKE; STAY OFF THE ACCELERATOR; AND COUNTERSTEER!** Steer in the direction to which the rear end of the vehicle is skidding. There are two points about counter steering: 1) the steering wheel does not have to be turned violently to correct a skid. This a common "panic" reaction, and further trouble arises because the rear tends to skid back and forth (fishtailing); 2) Once the wheel has been turned to counter-steer, it may be necessary to immediately counter steer in the other direction to help recover.

There are four basic types of skids. The following will describe them and methods of recovering from them:

- **Braking skids** – This skid occurs when sudden, hard brake pressure is applied causing one or more of the vehicles to lock. If the brakes are properly adjusted then all wheels should lock at the same time. Regardless of how many wheels lock, steering control will be lost. If all wheels lock evenly or if just the front wheels lock, the vehicle will move straight ahead, unless influenced by some other force (e.g. a dip in the road). If just the rear wheels lock, their reduced traction will cause them to move forward faster than the front wheels. The vehicle may spin 180

degrees. The vehicle may actually end up traveling in the opposite direction. The following actions should be taken if braking skid occurs:

- Release the brakes immediately; it should then be possible to steer. Releasing the brakes allows the wheels to turn.
 - If braking is still necessary, apply with less pressure so that the wheels don't lock again.
- **Power skid** – The power skid occurs due to sudden, hard acceleration. Since the power skid is delivered only to the rear wheels, sudden acceleration can cause the rear wheels to lose traction. The back of the vehicle may skid to one side, trying to overtake the front end. The tendency for the rear end to slide will be greatest if the front wheels are turned. The vehicle may even spin all the way around. To control this:
 - Ease off the accelerator.
 - Steer in the direction towards which the rear end of the vehicle is skidding.
 - Counter steer to set the vehicle straight.
 - Keep the front end up front.
 - Steer in the direction you want to go.
 - **Cornering Skids** – Cornering skids (also called yaw skids), occur when speed is too great or traction is reduced (due to poor road/weather conditions) such that the vehicle cannot stay on the intended track around a curve. This is primarily seen at exit ramps from highways. The cornering skid can even occur at normal speeds if the traction is reduced by tire or road surface conditions. The vehicle may continue on a straight path and not on the intended path around the curve. In a full cornering skid all four wheels lose traction. The rear end of the vehicle may try to overtake the front end of the vehicle if just the rear wheels lose traction. This is sometimes called a "spin-out". Actions to take if a cornering skid occur are:
 - Ease off the accelerator.
 - If the vehicle is spinning out, counter steer as space permits. This will align front and rear wheels and control may be regained.
 - **Hydroplane Skids** – Hydroplane skids occur when the tire is moving too fast for the water on the road to escape (to flow around it or through the tread). Hydroplaning can occur on minimally wet surfaces at speeds of 25 mph. A small wedge of water builds up in front of the tire and lifts it off the road surface. The results of a hydroplane skid are hard to predict. As in all skids, there is loss of braking and/or steering control and unless the driver attempts to brake or steer (other than straight ahead) the driver may not know the vehicle is hydroplaning. Actions to take if hydroplaning occurs:
 - Release brake and/or accelerator.
 - Allow the vehicle to decelerate. The weight of the vehicle will drop through the water barrier and recontact the road surface.

Remember: Speed initially causes hydroplaning; the second cause is tire and tread.

HANDLING OTHER VEHICLE EMERGENCIES

There are a number of other emergencies that can occur to the vehicles we use. The following are some possible emergencies and ways to control them:

- **Rapid Tire Deflations** - With rapid tire deflation, front-end occurrences are the most dangerous. The vehicle will pull to the side of the blowout or deflated tire. The driver should remove their foot from the accelerator, allowing the vehicle to slow gradually. Hold the steering wheel firmly; anticipate difficult steering. When the steering is controlled, brake lightly; avoid aggressive braking techniques. The vehicle will pull to the side of the deflated tire because the flat tire grips the road with more rubber (and more friction) and acts as a pivot. Aggressive braking will cause the rear of the vehicle to swing/skid around 180 degrees.
- **Brake Failure (conventional brakes)** – Brake failure in conventional systems generally results in negligence of the system, which in turn leads to failure. If failure occurs, let off the accelerator and pump the brake pedal rapidly. This might build up enough pressure (fluid) in the system and provide minimal braking action. If applicable leave the Jake brake / retarder system engaged. Down shift to the lowest gear on gear at a time. Additionally, apply the parking brake system pumping firmly, holding the release mechanism to prevent rear wheel lockup. As a last resort, as the vehicle slows, rub the tires against a curb for additional friction. If all else fails, look for an appropriate escape path.
- **Brake Failure (ABS/Air brakes)** - Anti-lock braking systems (ABS) are operated by a computer system. The computer rapidly applies the pumping action/friction to the pads faster than a human can with the foot. When ABS systems fail, the vehicles parking brake system reverts to conventional for the most part. However, initially, **do not pump an ABS system**. This will confuse the computer if the system is still functioning, and will not allow for even/smooth braking to occur on all four wheels. Apply firm pressure and hold in place. Down shift to the lowest gear on at a time, to slow the vehicle down. Leave the retarder system engaged. Again as a last resort rub the tires along the curb to slow the vehicle and if that fails look for an escape route. Never pump the brakes if the vehicle has air brakes. Air-brake failures are generally caused by an air-line failure or component failure. Pumping the brakes exhausts the remaining air more rapidly.
- **Transmission Malfunctions** – Transmission failures are rare in nature unless the driver shifts into reverse or park while driving. Most new apparatus as an electronic transmission that won't allow for those occurrences. Basically, vehicle operators will experience early indications

of trouble in the transmission (e.g. slipping, thrusting etc.). In these situations place the unit out of service and have a mechanic look at it.

- **Steering Malfunctions / Failures** - Power steering system failure is the most common. A power-steering failure occurs when the engine stalls, fluid in the system is low, or when the belt that drives the system flips or brakes. Regardless, the steering mechanism will still work, but it will require considerable effort to steer the vehicle. Complete failure of the steering system seldom occurs. IF complete failure occurs, release the accelerator, downshift to the lowest gear, and bring the vehicle to a stop.
- **Accelerator Sticks** - If the accelerator sticks, the driver should attempt to release the pedal by tapping on it with their foot. IF this fails then the driver should attempt to stick their foot under the pedal and pull it up. This should only be done with the foot and **NOT** the driver's hands. IF that does not solve the problem, put the vehicle in neutral and apply the brakes to slow the vehicle to a stop, downshift to the lowest gear on gear at a time. If the motor is shut down, beware that many breaking and steering systems require the motor to be running. Without the motor running, both of these operations will be more difficult.
- **Impaired Visibility** - If visibility should become impaired (hood flies up, wiper or defroster malfunction, the driver should open their window and stick their head out to see where the vehicle is going. Apply the brakes slowly as not to cause a rear-end collision and pull off the road.
- **Wheels of the Road** - If the wheels were to leave the road surface, the driver will have to perform an off-road recovery. When the wheels have left the road, hold the steering wheel firmly as the vehicle may pull to one side. Reduce speed by releasing the accelerator. If the brakes must be applied, they should be done so very gradually.
- **Danger Signals** - There are many forms of "danger signals" the driver should be aware of and be able to take the appropriate action to minimize or correct the problem. It is important to remember that if responding on an emergency incident and the vehicle has a malfunction, a replacement unit should be requested immediately as not to delay the assistance longer than it has to. Some danger signals to be aware of are:
 - Fuel gauge – loss of fuel or not proper quantity to start.
 - Charging system – If this fails, (battery not charging); turn off any equipment that will drain the battery. If the motor is stopped it is unlikely to start again.
 - Brake warning light – Stop immediately. If there is a complete brake failure, use the procedure outlined in the brake failure section listed previous.
 - Oil pressure - If it drops, stop the vehicle immediately. Do not drive until maintenance has been performed.
 - Engine temperature – If it rises into the danger zone (and remains), stop immediately and do not drive the vehicle until maintenance is performed.

EMERGENCY PARKING PROCEDURES

Position of an emergency vehicle on and emergency incident is crucial. The more likely a hazard it represents, the more critical the need for rapid, effective placement of stationary warning devices. The most effective is the placement of reflective triangles or flares to warn drivers of the upcoming situation. Remember that if there is a potential for flammables spilled, the reflective triangles are the better choice. It is a goal to protect the scene and the personnel operating on the scene. The goal of "protecting the scene" is to provide visible, early warning to surrounding traffic and thus avoid a collision (or avoid causing a collision).

Some simple tips to use for identifying and protecting the apparatus and personnel. During daylight hours and the vehicle is off the road the use of hazard lights (four way flashers) should be sufficient. IF the apparatus is still on the road then the use of emergency lights, hazard lights, and some other form of warning devices should be used (e.g. traffic cones, triangles, or flares). During darkness, use of as many lights as possible is the best safety. The lights generally cause traffic to slow to a safe speed around the apparatus.

If the need for additional traffic warning devices is warranted, then ensure that plenty of warning is given to oncoming traffic. Terrain and visibility may require that the additional warning devices be placed well behind the apparatus and in some cases around a curve or over a hill. Actual distances are based on the topography, buildings, and visibility conditions.

Safety Reminder – If you position yourself behind any parked emergency vehicle for the purpose of spotting and/or warning approaching traffic, you run the risk of being struck. Be vigilant, people are struck because they are not looking. **Never** turn your back on approaching traffic.

COMPETENCY COURSE PROCEDURES

PURPOSE OF COURSE

The competency course is designed to measure the proficiency of emergency vehicle drivers. The course is designed to measure a driver's skill, knowledge, and judgment. It can also identify to the candidate the limitations of the vehicle while completing eight specific exercises. The competency course is designed to fulfill one of several purposes:

- Assist in the training of a candidate emergency vehicle driver.
- Verify the competency of an existing vehicle driver.
- Examine the proficiency of an existing emergency vehicle driver.

Driving the course requires completing each station under ideal conditions in a controlled environment. Actual driving conditions represent less than ideal conditions because of constantly changing situations. There are specific performance criteria that are crucial to achieving proficiency while completing the competency course. They are as follows:

- Comfortable seating position.
- Ease and convenience for reaching all controls of the vehicle.
- Proper hand position on the steering wheel.
- Careful vehicle control.
- Precise steering adjustments.
- Consistent vehicle speed.
- Proper adjustment and effective use of vehicle mirrors.

To successfully be evaluated as an emergency vehicle driver requires more than the completion of the competency course. It must be supplemented by other exercises including street and highway driving in order to fully comply with NFPA 1002. The candidate should be taken through a predetermined route on a public way. Some of the actual activities that must be completed as a part of the over-the-road driving portion include but are not limited to:

- Make four left and 4 right turns.
- Travel either a straight section of urban business street that is several blocks long or a minimum of one mile or a 2 lane rural road.
- Travel across at least one through intersection and a minimum of two intersections where stopping is required.
- Travel over at least one railroad crossing.
- Travel on a road with at least one curve to the left and one to the right.
- Enter and exit a limited access highway. Use a conventional ramp entrance. Travel the highway a sufficient distance so as to safely execute two lane changes, one to the right and one to the left. Exit off a conventional ramp.
- Proceed down a grade. It shall be steep enough and long enough to require braking or shifting.
- Proceed up a grade. It shall be steep enough and long enough to require shifting to maintain a constant speed.
- Travel under, over, or across an underpass or bridge. It shall present either a vertical or horizontal restriction.
- Travel along or over any unusual or unique roadways or features that present a special consideration in the operation of the vehicle.

RULES AND PROCEDURES

In order to maintain safety during the competency test it is important that certain rules be followed. Many of these rules flow into normal operation of an emergency vehicle. The following should be deemed as the course rules:

1. Vehicle performing maneuvers on the course will have their headlights on.
2. No unauthorized vehicles or drivers allowed on the course during any exercise.
3. All vehicle occupants must wear occupant restraint devices.
4. Persons assigned to reset cones will wear bright clothing, safety vests, and stand clear of the traveled area.
5. Maximum speed on the course should not exceed 20-30 mph.
6. The distances between cones in any exercise may be adjusted to accommodate different lengths or widths of vehicles.
7. Course exercises will not be held outside if the course is icy or snow covered.
8. All vehicles will have a pre-trip inspection performed on them prior to using them for the competency course or over-the-road evaluation.

COMPENTENCY COURSE DESCRIPTION

STRAIGHT LINE EXERCISE: The purpose of the straight line exercise is to familiarize the driver with operating the vehicle within close quarters both in forward and reverse; and, to enable the driver to adjust the mirrors for proper viewing, make minor steering adjustments, and gain confidence in transversing a restricted area.

This exercise is typically the first station in the competency course. The area is 6' 8" wide and is measured from inside edge of cone to inside edge of cone. It is 200' in length and has cones spaced along the sides of the course at intervals of 20 to 25 feet.

The exercise begins upon entering the straight line at the entrance. The driver travels through the exercise by "hugging" to the left side; stopping at the end of the station; and backing out of the course without brushing or knocking over any cones.

CONFINED SPACE TURNAROUND EXERCISE – The purpose of the turnaround exercise is to allow the driver to become familiar with the turning radius of the vehicle; and, to permit the driver to interpret depth perception

involving the placement of the rear of the vehicle as seen through the vehicle's mirrors.

This station is in an area 50' wide by 100' long. Cones are placed intermediately along the length of the area at 20 to 25 foot intervals. The entrance is at the center of the 50' side of the station.

The driver begins the station by entering and proceeding diagonally toward on corner of the confined space. The vehicle is then maneuvered back and forth without projecting outside of the areas boundaries until it can be driven out of the confined space. This exercise is **NOT** a three-point turn. It may take up to 6, 7, or 8 turns for larger vehicles to accomplish the 180-degree turn.

ALLEY DOCK EXERCISE – The purpose of the alley dock exercise is to familiarize the driver with positioning of the vehicle to back into a confined space; and, to judge depth perception and distance using the vehicle's mirrors to position the rear of the vehicle at or close to a fixed point.

This section is exactly 10 feet wide, measured from inside of one cone to the inside of a cone and 30 feet long. The 30 feet can be used for all vehicles no matter the length of the vehicle since the vehicle does not have to be all the way in the dock area.

This exercise begins when the vehicle proceeds past the alley dock so as to position it for backing into the alley. The intent of the exercise is for the vehicle to be backed into the alley and stop within 6 inches of the back of the alley.

SERPENTINE EXERCISE - The purpose of the serpentine exercise is to familiarize the driver with the location of the corners of the vehicle for maneuverability purposes and the turning radius while moving forward and backward; creating a confidence in using the mirrors for this exercise.

The serpentine is an area 50 feet wide by 200 feet long. There are 4 cones set in the center of the 50-foot width and the cones are set at 40 feet apart, measured center to center. For vehicles with a wheelbase of less than 170 inches, the distance between the centers of the cones is reduced to 34 feet.

Upon entering the exercise, the vehicle should be driven along the right side of the center cones. After passing the 3rd cone the vehicle should be cocked at a slight angle so as to position the rear of the vehicle between the 3rd and 4th cones. The driver then backs the vehicle between them, passing to the left of the 3rd cone and to the right of the 2nd cone. Then the driver should pass to the left of the first cone and back through the entrance. After backing through and stopping at the entrance, the driver travels through the serpentine in a forward position. The vehicle should pass to the right of the first cone, the left of the second cone, right of the third cone and out the exit of the exercise.

OFF-SET ALLEY EXERCISE - The purpose of the off-set alley is to allow the driver to become aware of the front and rear tracking of the vehicle; familiarizing the driver with depth perception through the vehicles mirrors, especially recognizing the location of the right rear wheel.

The distance between the two alleys is 48 feet. It must be carefully measured from edge of cone to edge of cone. An extended front bumper or other projections of the vehicle must not extend outside the alleys. In other words, treat the alley edges as if they are building walls or parked vehicles.

When transversing the exercise the driver should proceed forward through the first alley and exit it. The driver should change the track of the vehicle and enter the second alley without rubbing or knocking down any of the cones. Typical problems involve changing the track of the vehicle too quickly or not straightening the vehicles track sufficiently before entering the second alley.

PARALLEL PARK EXERCISE - The purpose of this exercise is to allow the driver to understand the importance of vehicle positioning prior to starting a movement that requires exact right side placement; to familiarize the driver with the turning radius of the vehicle as it impacts restricted space placement; to enable the driver to locate the position of the right front extremity of the vehicle while completing a maneuver; and, to enable the driver to place the right side of the vehicle at a specific point utilizing the vehicles mirrors.

The parking space that the vehicle is to be placed in is **the length of the vehicle plus eight feet**. The depth of the parking space is eight feet and a marking of 12 inches should be marked away from the curb.

The driver shall pull the vehicle past the parking space and proceed to parallel park the vehicle in the designated space. The right side of the vehicle must be placed within 12 inches of the curb. Crossing over the curb, parking too far away from the curb, or knocking down cones that mark the parking place will result in penalty points added to the drivers score.

DIMINISHING CLEARANCE EXERCISE - The purpose of the diminishing clearance exercise is to familiarize the driver with the importance of properly aligning a vehicle when entering a very confined asymmetrical area; and, to familiarize the driver with traveling through a continually more confining restricted area.

This portion of the course uses an area approximately 100 feet in length and the entrance to the station is nine feet six inches wide, inside cone to inside cone. The end of the exercise measures eight feet two inches wide, inside cone to inside cone edge.

The vehicle is to pass through the length of cones without touching or knocking and cones over. Two of the most common errors involve speed fluctuations through the exercise and misalignment of the vehicle's track upon entering the station.

STOPPING EXERCISE - The purpose of the stopping exercise is to familiarize the driver with the position of the front of the vehicle and to require the driver to brake smoothly and precisely while bringing the vehicle to a stop at a specific point.

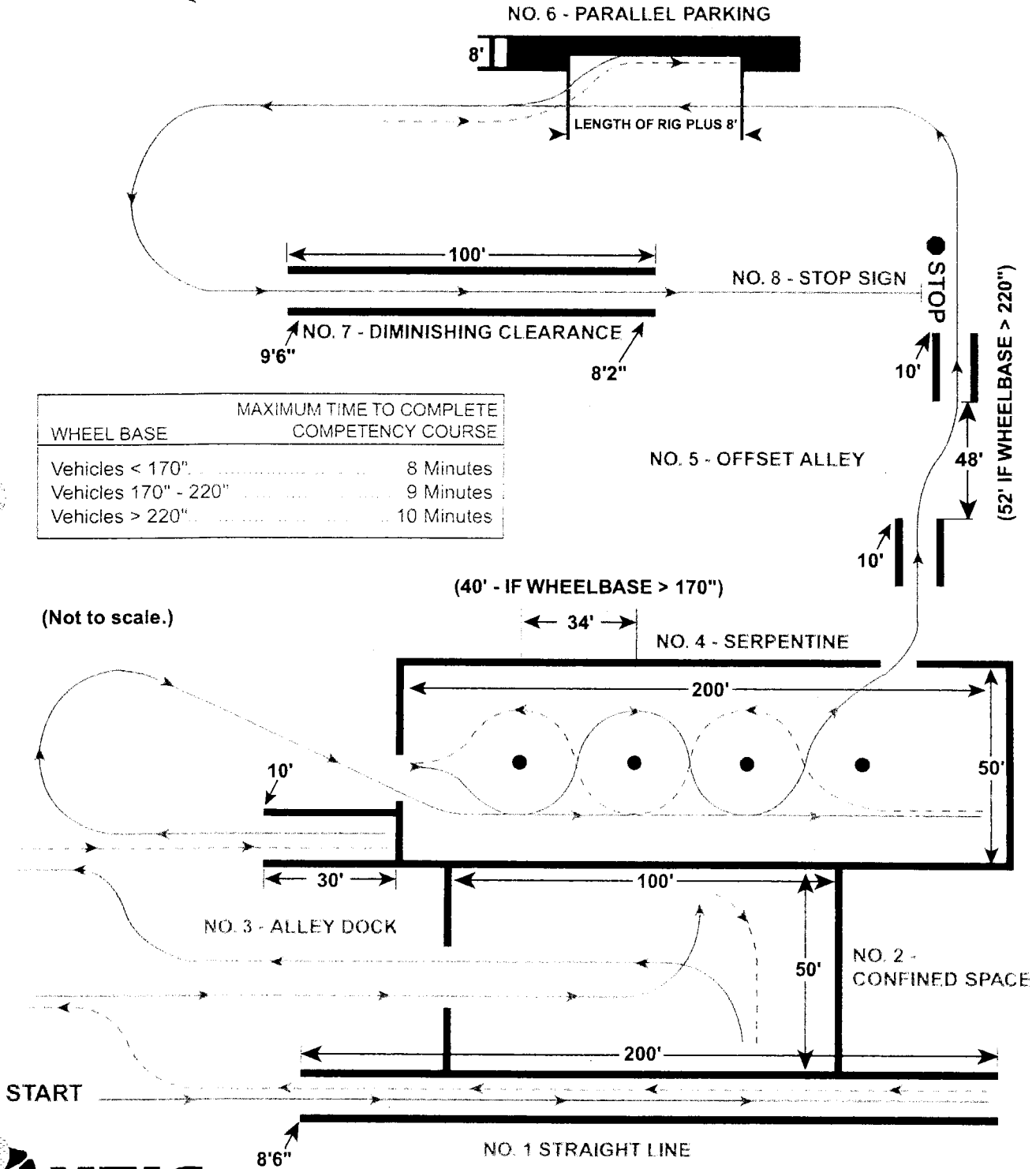
At approximately 40 to 60 feet beyond the end of the diminishing clearance station, two cones will be set parallel to each other and in the line of travel of the vehicle. Marks at 6 inches, 12 inches, and 18 inches from the cones will be made on the ground.

The vehicle will exit the diminishing clearance and proceed straight towards the two cones. The vehicle will then slow and come to a complete stop no more than 6 inches from the cones. The farther away from the cones will result in more points being added to the drivers overall score.

COMPETENCY COURSE

REVERSE →

FORWARD ←



WHEEL BASE	MAXIMUM TIME TO COMPLETE COMPETENCY COURSE
Vehicles < 170"	8 Minutes
Vehicles 170" - 220"	9 Minutes
Vehicles > 220"	10 Minutes



For more information, see instructor's guide and videotape.



Brush Fire Tactics



On brush fires the strategy is to control the fire by containing it or extinguishing the fire by either removing the fuel, heat, or oxygen. The fuel can be removed by digging or scraping a control line with hand tools. The oxygen can be removed by smothering the fire with dirt. The heat can be reduced by applying water.

Fire behavior will be influenced by the following factors:

Weather- Wind can cause a fire to change directions, increase in size, and increase the speed in which the fire moves. The fire will be moving the direction the wind is blowing. Relative humidity plays a large role in both ignition and rate of spread. When the humidity is lower, fire behavior increases. Watch out when the relative humidity drops below 30% or the winds are above 25 mph. An increase in air temperature may cause increased fire behavior. A spot weather forecast can be requested through the National Weather Service. A spot weather forecast will provide expected weather in the immediate vicinity of the fire.

Fuel- The type of material burning (fuel) plays a large role in the rate of spread and intensity of the fire. Tall dry grass can spread rapidly and with burn with great intensity in moderate wind while a woods fire would spread much slower under the same weather conditions. In a woods fire the surface fuels are cooler, moister and not impacted as much by the wind. Dry leaf fires can have high or low spread rates depending on the weather and moisture. Fuel moisture increases or decreases the burn potential respectively.

Topography- The terrain on which the fire is burning can affect the fire behavior. A fire moves much faster uphill than on flat ground and will only creep downhill unless a strong wind is pushing it there.

Knowing all this, the most dangerous scenario would be to attack the head of a fire in tall dry grass from the unburned side from an uphill and downwind position of the fire.

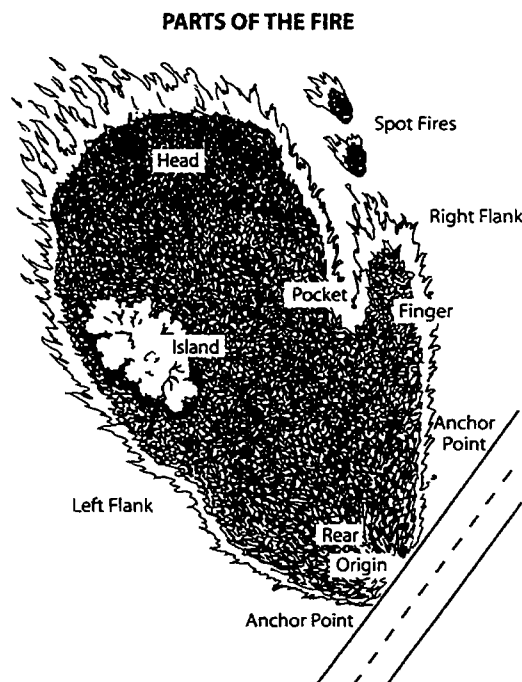
Size up- A tail gate briefing is essential before beginning the fire attack. It is OK to trade acreage for time. The following factors need to be considered before deploying resources:

Weather- What is the wind direction and strength? What is the relative humidity? What is the predicted weather? What time of day is it? (Fire behavior increases during the afternoon. From 1000 - 1800 is called the critical burning period.) Is there a red flag warning today?

Fuel- What fuels are burning? (grass/leaves/woods) A grass fire can move fast and have tall flames. Leaves can move quickly with medium height flames. A fire in the woods will move slowly and with small flame lengths. What fuel types are ahead of the fire? Are the fuels moist or dry?

Topography- What is the terrain involved in the fire? How will the topography affect fire behavior? What is the terrain ahead of the fire? Are there natural or man-made firebreaks that can be used as anchors for launching the initial attack? (roads, streams, trails, rocks, dirt fields) Use the topography to your advantage.

Fire Behavior- Is the fire large or small in size? Where is the head of the fire? Is the fire spreading rapidly? What will happen if the wind increases? Are the flames taller than four feet? When flame lengths are less than 4 feet, a direct attack could be possible at the head or flanks of the fire by personnel with hand tools and hose lines. If flames are taller than 4 feet, the fire is too intense for a direct attack by personnel on foot.



Hazards- Are there downed power lines? Are hazardous materials present? How many hazard trees have you identified? Who will flag the collapse zone around the hazard trees?

Resources- What apparatus and staffing were dispatched? What personnel and equipment will it take to contain the fire? What are the capabilities and limitations of these resources? Do we have sufficient water supply?

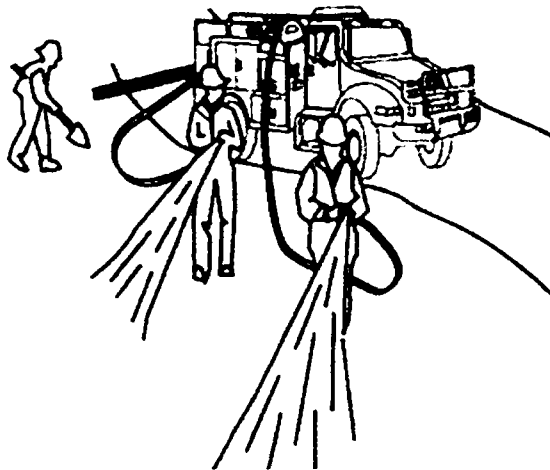
Values threatened- Is there a life safety hazard to the public? Are there Structures or other valuable property that need to be protected? Is there a need to rush the fire attack?

Tactics- There are several functions a brush truck might perform on a brush fire including initial attack, mop-up, and fire line patrol. Although a brush truck can respond driver only, on the scene they need to be staffed with a nozzle person. When given an assignment, they should pair up with personnel with hand tools for most maximum efficiency.

Initial Attack- How aggressive should this fire be attacked? Where would this fire go if we did nothing? What tactic will work best?

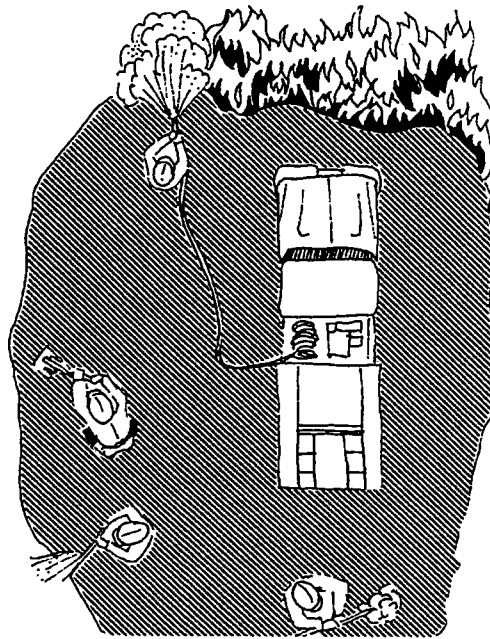
Direct Attack- A direct attack is an aggressive, offensive attack at the fire's edge from the black. It should be used when flames are less than four feet tall. It generally works best in light fuels, low wind speeds, and light intensity fires. The major advantage of direct attack is the immediate availability of the burned out area ("the black") as a safety zone. An anchor point must be used to launch the attack. The disadvantages of this tactic are that personnel are exposed to heat and smoke and that it is ineffective for fast moving fires.

Brush trucks are invaluable when used for direct attack, especially in light grassy fuels. Personnel with hand tools should work closely with crews using hose lines. This coordination can reduce water use significantly. Water should be used sparingly and wisely by applying it in short bursts. The brush truck operator and nozzle person must be in constant communication over progress, water supply, and fire behavior. Use Class A foam or surfactants if available. Dish detergent can be added to tank water to act as a surfactant. Surfactants improve the penetration of water, reduce friction loss, and absorb more heat by reduced surface tension. Brush trucks should be rotated out as their water supply is diminished.

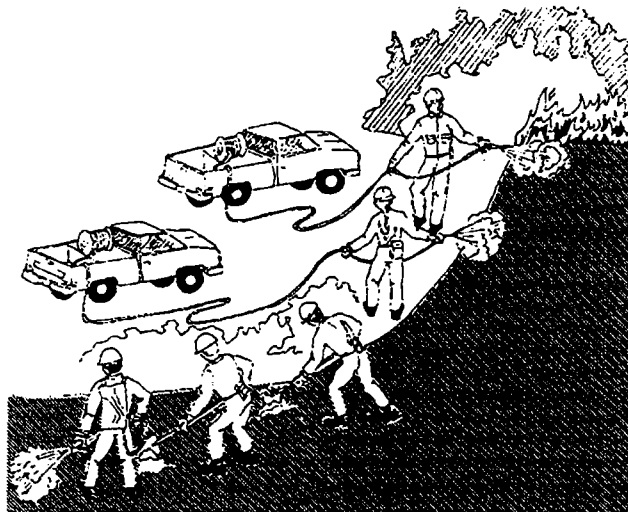


Mobile- When terrain and fire behavior allow, this tactic is the fastest and most effective method. The brush truck is driven in the black along the fire's edge while the nozzle person knocks down the flames. Personnel with hand tools

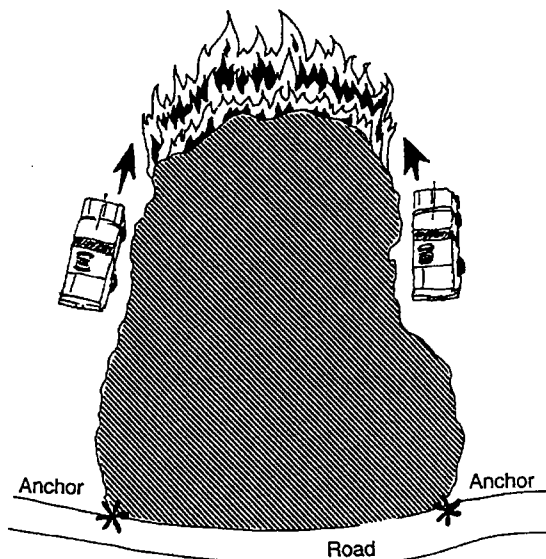
follow behind and contain the fire. Never allow personnel to ride on the outside of the apparatus during a mobile attack. The brush truck driver must have the nozzle person in view at all times when using a mobile attack. If the nozzle person is out of view, the driver must stop the vehicle until the nozzle person comes back into view. The hose line should be kept as short as possible to prevent this.



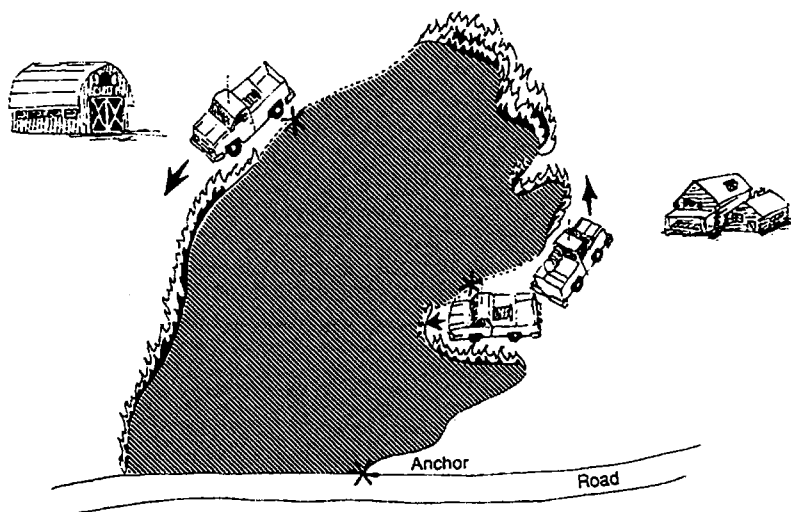
Tandem- Two engines are used in series a mobile attack. From the back, the first brush truck hits the hot spots and the second one follows up extinguishing the fire. Hand tools are used to ensure containment.



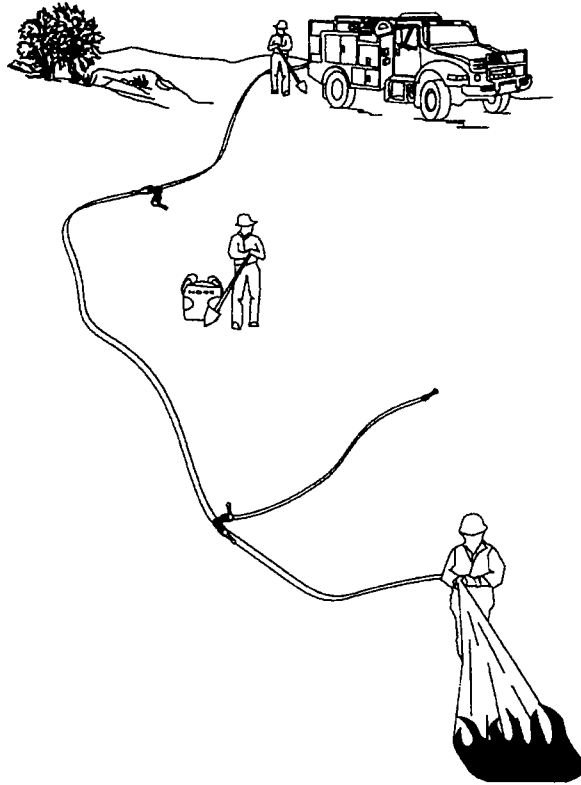
Pincer- This tactic uses two or more brush trucks in the black to attack the flanks and continue toward the head of the fire in an attempt to pinch it off.



Envelopment- The envelopment tactic involves attacking multiple critical segments or structures around the fire area at the same time. Establishing anchor points for the different attack locations is required to keep from being outflanked or overrun by the fire. Critical areas are attacked first using the hot spotting technique. From the black, the brush trucks move towards each other, tying their control lines together. This tactic requires good communication and coordination.



Stationary- Uses an attack line from a parked brush truck to reach areas inaccessible for a mobile attack. The attack should be made from the back.



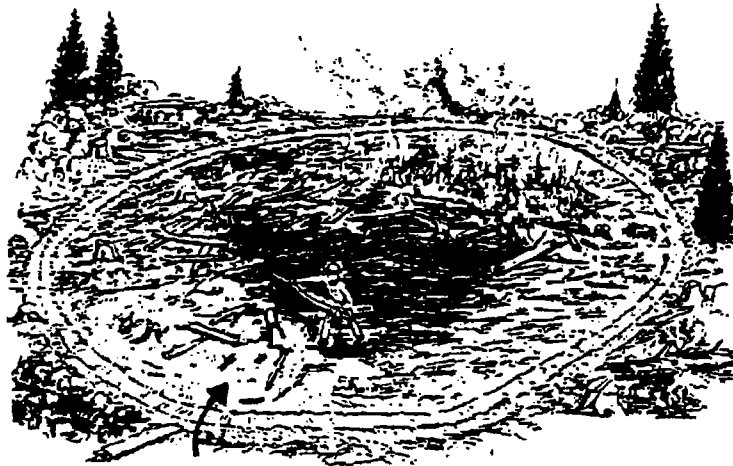
Size up questions- What barriers can we use as anchor points?

Parallel Attack- This attack strategy works by constructing a control line parallel to but farther away from the fire edge than in direct attack. This may shorten fireline construction by cutting across unburned fuels. This strategy places firefighters in the path of the fire with no "back" as a safety zone. For this reason, the fuel between the fire and the control line needs to be burned out by firefighters igniting the fuel along the control line. This is called "dragging the back" with you. Although unlikely, it is possible that this tactic could be used in Montgomery County.

Indirect Attack- This strategy is similar to the parallel attack only the control line is built much farther away from the fire edge. This technique is unlikely to be used in suburban areas such as Montgomery County.

Mop-up- This important task can be slow and tedious. The goal is to insure that the fire is extinguished and will not escape the control line. Spot fires outside the line are extinguished. All hot spots inside the control line must be dug out and cooled with water. If the fire involved heavy fuels such as logs and brush piles, the overhaul/mop up work may take hours. Smoldering debris can be piled together (bone yarding) and allowed to

burn. Light fuels such as grass will not usually take extensive efforts. Hand tools and backpack pumps work well for this task.



BONE YARD IN CLEARED AREA

Brush trucks may be used to provide water for backpack pumps. Surfactants work exceptionally well during mop up. Be sure to flush the tank and pump with clean water at the conclusion of firefighting operations. Be alert for hazard trees, burning stump holes, and fatigue. Appropriate PPE must be worn during mop up operations. Eye protection is extremely important due to amount of dust and ash present. The goal is to mop up the entire area until the burn area is cold.

Fireline Patrol- After overhaul/mop up it is often necessary to police the area for smoke and hot spots. This is especially true of deep-seated ground fires. Peat fires are particularly troublesome.

Safety- The danger of changing fire behavior makes these precautions necessary when performing initial attack on brush fires.

Always wear and use appropriate PPE. Turnout gear is not appropriate for brush fires.

LCES- This acronym should be memorized to help the brush truck operator recall the fireground hazards.

Lookouts- Assign knowledgeable and experienced lookouts or safety officers to watch for:

- Inappropriate PPE (structural PPE is inappropriate)
- Hazard trees/collapse zones (flagged in black and yellow striped ribbon)
- Increased fire behavior
- Changing weather conditions
- Inappropriate tactics
- Freelancing
- Crew locations and accountability
- Location of escape routes and safety zones

Communications- Miscommunication can mean disaster. A size up needs to be completed and a tailgate briefing held. Brush fires are rarely true emergencies and in Montgomery County almost never a threat to life of the public. Slow down and take the time to communicate the plan. Make sure the following things are communicated before making a fire attack:

- Size up findings
- Current and expected Weather
- Current and expected fire behavior
- Location of Escape Routes and Safety Zones
- Type of fire attack and strategy
- Radio talk groups to be used
- Ensure instructions are understood
- Radio designation of lookout/safety
- Hazards

Escape Routes- These are the designated trails that will be used to reach safety zones should the fire threaten personnel or brush trucks.

- May require change as the fire progresses
- Need to be scouted and flagged with high visibility ribbon
- Travel time is related to topography, fitness of personnel, and route length

Safety Zones- A safety zone is a nonflammable area of refuge where personnel can wait out unexpected increases or changes in fire behavior. A wind shift can necessitate the evacuation to safety zones. Multiple safety zones should be identified.

- May change locations as the fire progresses
- Must be close to where personnel are working
- Can be the black
- Located to avoid hazardous terrain features
- Must be large enough to protect from extreme fire behavior

Personnel should not work under overhead power lines. They can burn through and drop to the ground.

Personnel must take notice of hazard trees and stay clear of them if possible. Hazard trees should be marked with hazard ribbon.

When using a stationary attack keep a charged line at the brush truck for your protection.

The brush truck should keep 25% of its tank water in reserve for protection. Due to the limited water supply on a brush truck it is important to refill the tank at each opportunity.

If trapped in the path of an oncoming fire front, position the brush truck in the least amount of vegetation and take refuge in the cab of the brush truck. Keep the pump running and use an attack line to deploy a fog pattern over the cab. Deploy ground sweep nozzles if available. If the motor has choked out, there is not enough oxygen outside for you either. If the vehicle catches fire so will you if you go outside. The cab will normally burn last and may buy you time until things outside cool down. Stay inside the cab until it is safe outside.

Limitations- Brush trucks have restrictions such as woods and rugged terrain that may restrict their mobility. Stationary pumping can still be used. It's possible to have extreme fire behavior in tall dry grass that would prohibit any attack on the head of the fire. Water supply limitations will affect which tactics can be utilized.

Decision time- What are my options? What plan of attack is most appropriate? Will I need additional resources to implement my initial attack strategy? What quantity and type of other resources might I need? Where will you launch the initial attack? Is this a safe strategy? Do I have units in staging that might be needed?

Re-evaluate- Are the strategy and tactics working? Is it safe to continue our attack? What are my trigger points for switching to a defensive mode? Has there been a change in weather or fire behavior? What is plan B?

If this seems like overkill, consider these facts:

Downed power lines on brush fires have killed structural firefighters.

Structural firefighters have been killed from heat stroke on brush fires.

Structural firefighters have been burned over and killed on brush fires.

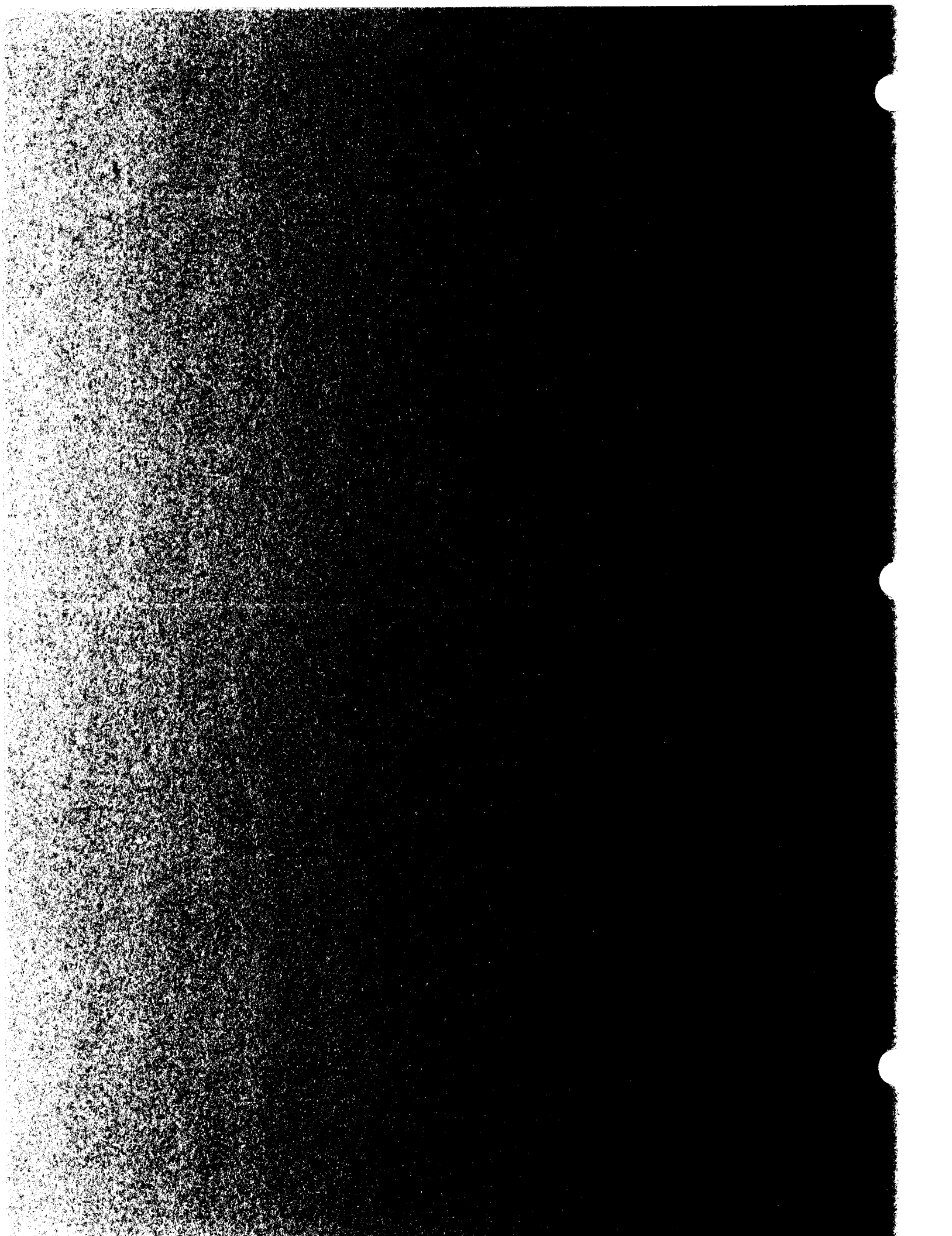
The four most common denominators of fire behavior on tragedy fires:

Most incidents happen on small fires or isolated sections of large fires.

Flare-ups generally occur in deceptively light fuels, such as grass and light brush.

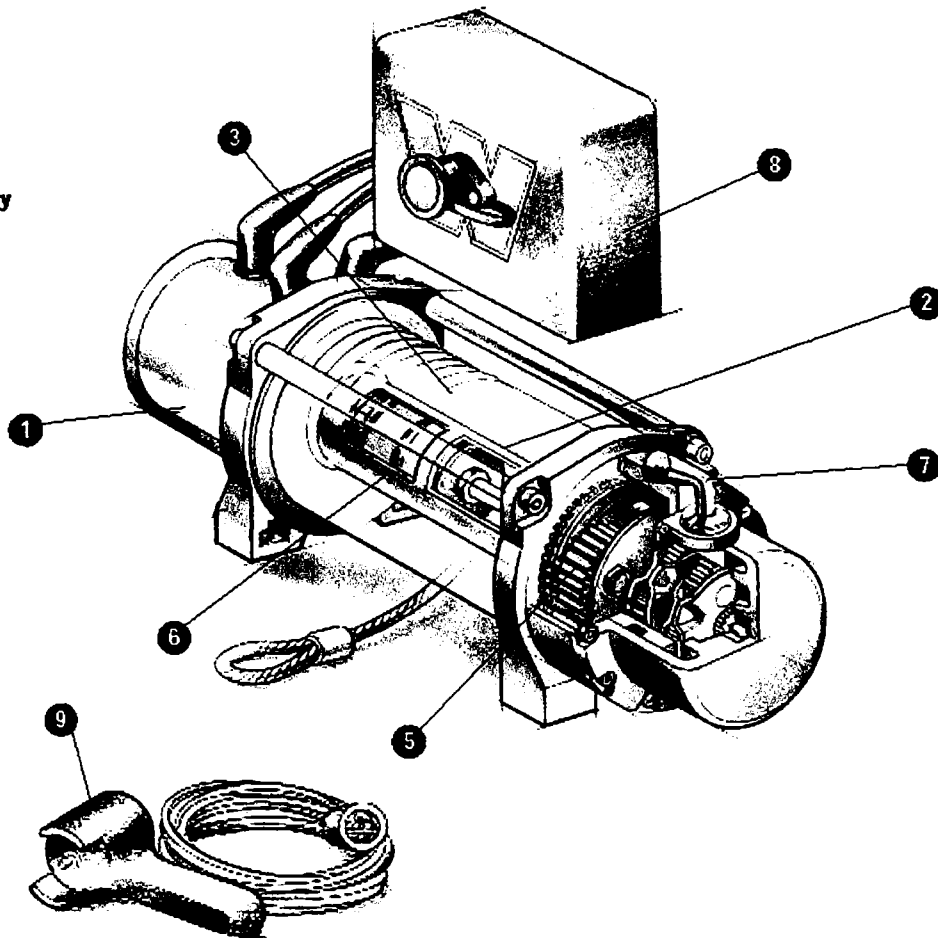
Most fires are innocent in appearance before unexpected shifts in wind direction and/or speed result in flare-ups. Sometimes tragedies occur in the mop up stage.

Fires respond to large and small scale topographic conditions, running uphill surprisingly fast in chimneys, gullies, and on steep slopes.



Winching Techniques

Structural components of a planetary gear winch



Safe Winching Operations

1. As the brush truck operator, it is imperative that you familiarize yourself with the type, model, and characteristics of the winch you will be using. This should be done during training and not on an incident. The operation of winches varies from one model to another. What may be a standard procedure on one model can be an unsafe action on a different winch.

2. Winching should be done with a two person crew, spotter and winch operator. This will allow both to evaluate the hazards and success of the operation from different view points. Both should be wearing leather gloves and eye protection.

3. Know the rated capacity for the winch and do not exceed it. Maximum pulling capacity of a winch is accomplished at the first layer of cable on the drum. Each additional layer of cable on the winch drum reduces the capacity by 10-12%. For that reason, it is best to un-spool as much cable as possible, always leaving at least 5 wraps of cable on the drum.

4. Select an anchor that is capable of withstanding the load.

5. Using a pulley attached to the load/anchor can almost double the capacity of the winch or make up for pull lost by having multiple layers of cable on the winch.

6. Cable failure during a winching operation can whip in any direction in a sudden, violent reaction. The following will reduce the possibility of cable failure:

Never connect the hook back onto the cable. Always use a sling or chain to attach the hook to the load/anchor.

Use a pulley and attach the hook to the frame of the brush truck not the winch mounting hardware.

Do not attempt to pull a load with the brush truck using the winch cable. This can cause cable failure.

Always leave at least 5 cable wraps on the winch drum.

7. When pulling a load, set the parking brake and chock the rear wheels. Place the transmission in neutral to prevent damage to the transmission. When using the winch for self recovery, place the transmission in neutral and allow the winch to work.

8. The maximum angle that the winch can be used is 45 degrees in any direction. A change of direction pulley may be used if needed to keep the angle under 45 degrees.

9. Placing a tarp or turnout coat on the cable will reduce the whipping action of the cable should cable failure occur.

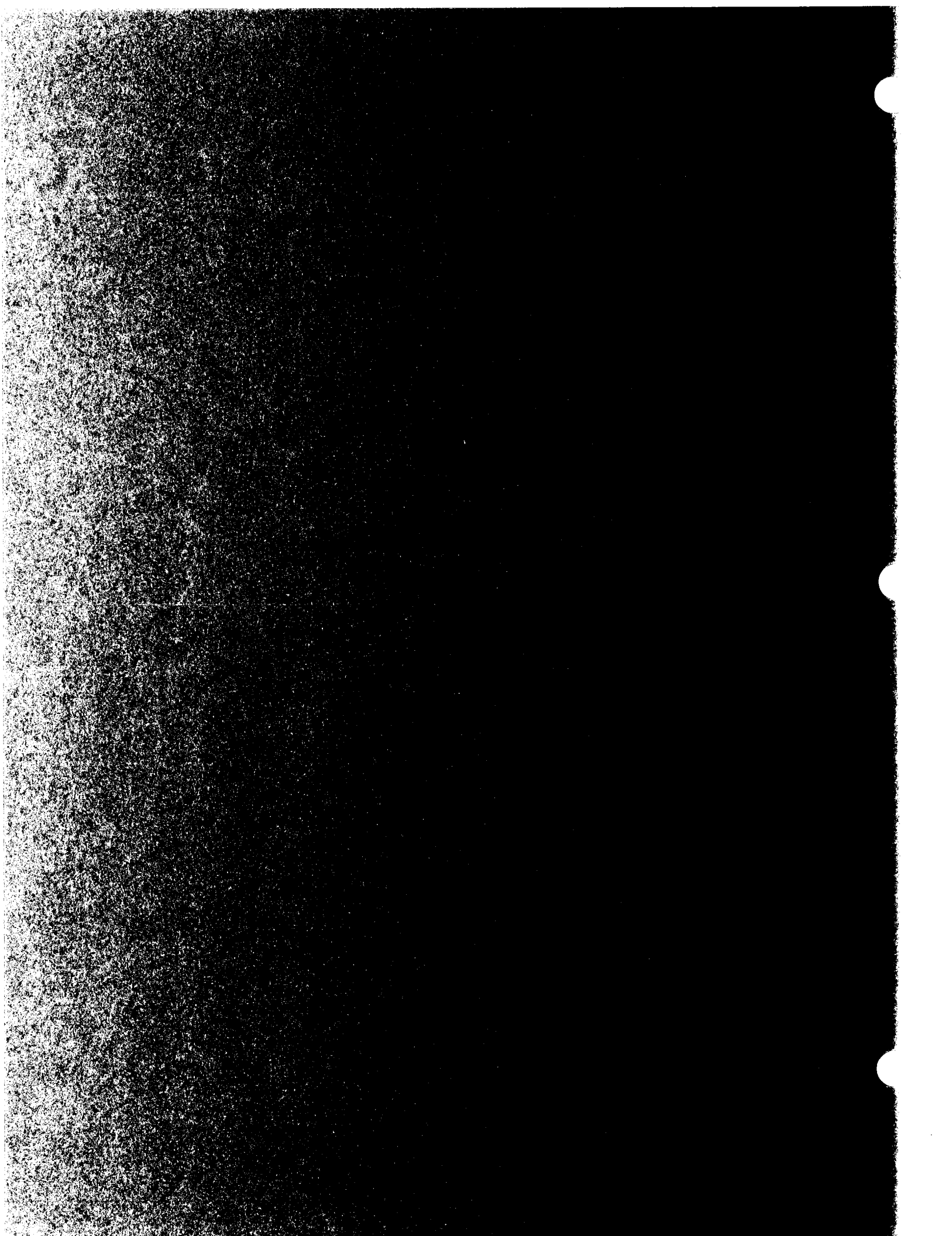
10. Never leave the remote control plugged into the winch while free spooling, rigging, or sitting idle. Have the remote control plugged in only during the actual winching operation.

11. Never engage or disengage clutch if the winch is under load, cable is tensioned, or cable drum is moving.

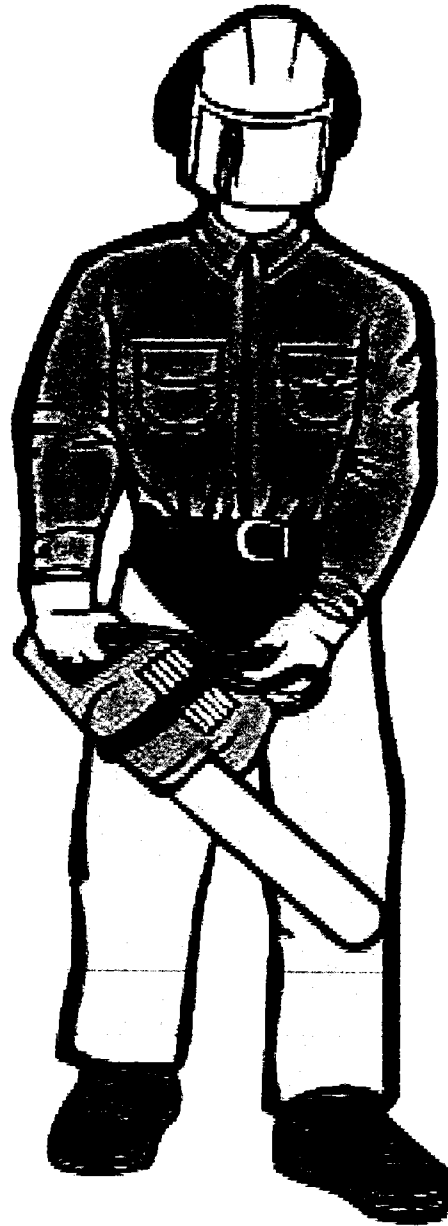
12. As a precaution for cable failure, keep all people a safe distance away when pulling the load. If the remote control is not long enough to have the winch operator a safe distance away, he should sit in the cab of the brush truck. The hood may be raised for additional protection.

13. Run the winch for no more than two minutes at maximum capacity. Allow the winch to cool down if it becomes hot to the touch.

14. When spooling the cable, distribute it evenly and tightly on the drum. This will prevent it from creating a bind.

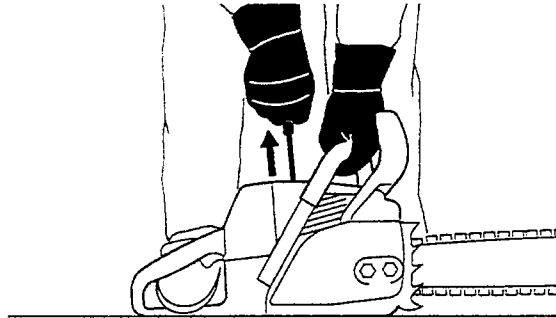


Chain Saw Safety

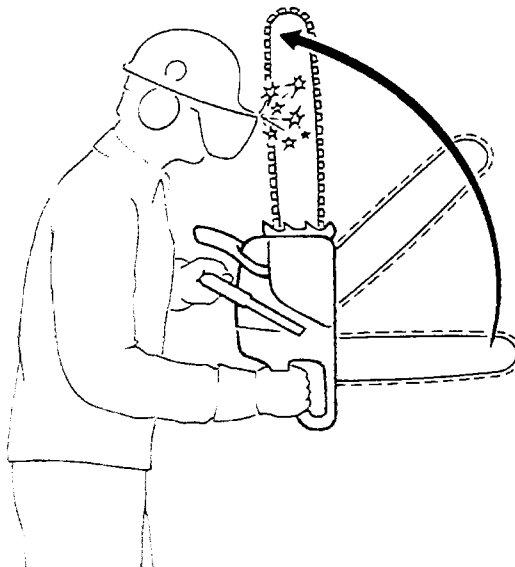


Chainsaw Safety

1. Never use a chainsaw alone. Using the three person saw team concept provides a lookout for overhead and surrounding hazards, cut debris removal, and allows the saw operator to focus on cutting. The saw operator maintains control of the saw while one crewmember removes cut debris and the other watches for hazards.
2. The saw should be started on the ground by placing your right foot into the rear handle. Activate the chain brake. Use your dominant hand to give strong brisk pull.

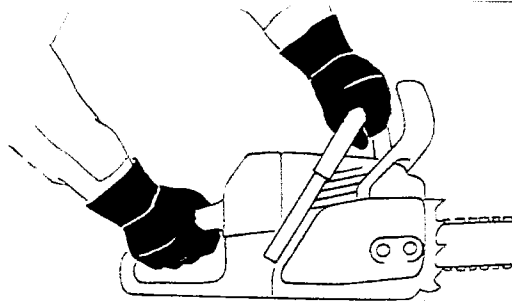


3. Kickback is a sudden rearward motion of the saw that occurs when the upper tip of the bar touches an object. The chain can come in contact with the operator and cause serious injury.

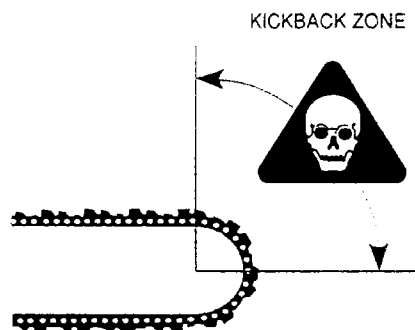


Kickback can be prevented by:

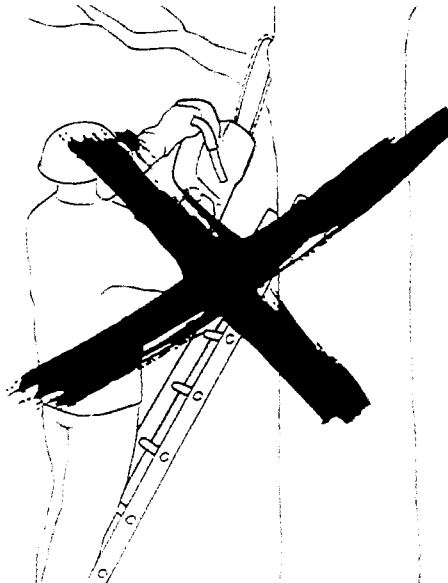
Proper Hand Grip



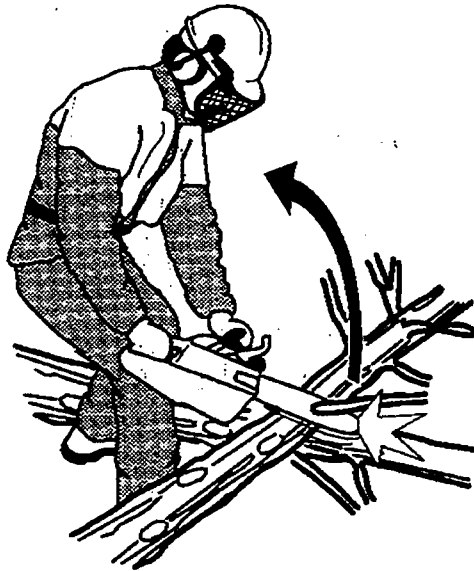
Do Not Cut Using Kickback
Zone of the Bar



Avoid off-balance
working positions (Do
not work higher than
chest level)



Avoid inadvertent
contact with the tip of
the bar.

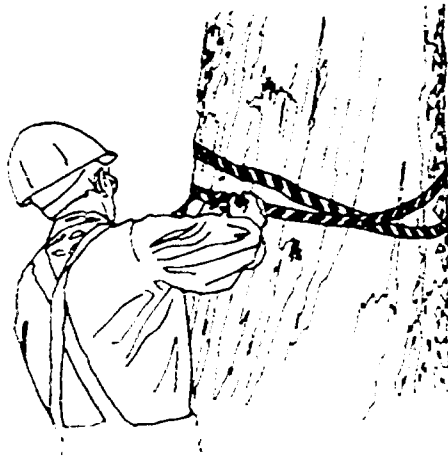


Cutting at full speed
Using Proper working techniques
Using a saw that has a chain brake (mandatory)
Staying focused and alert to the possibility of kickback

4. Safe operation includes the use of leather gloves, eye protection, hearing protection, helmet, and saw chaps for the chain saw operator and all other personnel on the saw team.

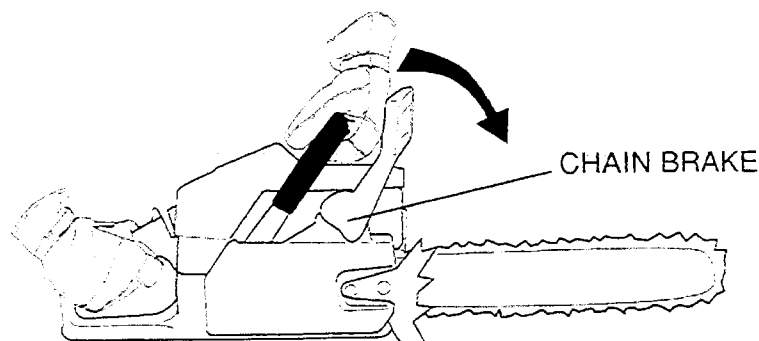


5. Do not work under hazard trees and watch out for falling branches (widow makers). Flag hazard trees with ribbon to warn others.

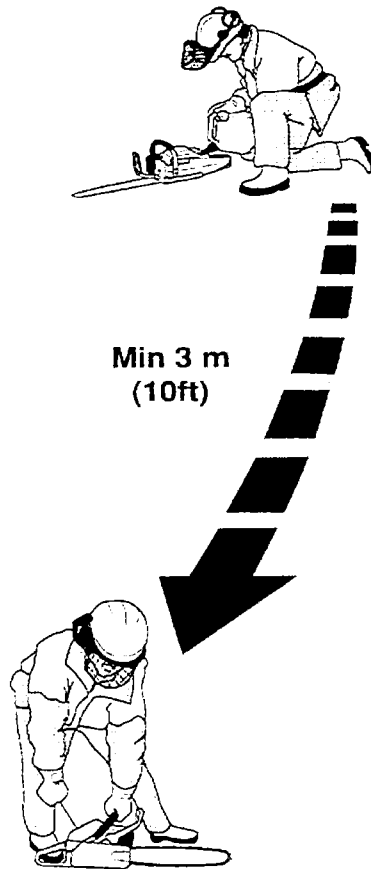


6. ****WARNING**** The execution of felling a tree requires a thorough understanding of falling operations and experience in woodcutting. The fireground is not the place for novice saw operators. Trees weakened by fire damage are even more dangerous. If you do not have previous training and experience, stay away from the saw. If you are asked or ordered to drop a tree that is unsafe, refuse and involve the safety officer if necessary. Flag the hazard tree as a warning to others.
7. The chain brake should be manually activated before starting the saw, when taking more than two steps with the saw, and when holding the saw with one hand.

ACTIVATE THE CHAIN BRAKE



8. Limbing or bucking up a downed tree is also dangerous if the mechanics of tree binds are not understood. Again, if you do not have previous training and experience stay away from the saw. The operation of a saw under the guidance of an experienced operator is a good way to increase your ability to use chain saws safely.
9. After fueling the saw the operator should move at least ten feet away from the fueling site before starting the saw.





Basics of Four Wheel Drive

Four Wheel Drive (4WD) offers better traction when in adverse road surface conditions.

Engage 4WD only on road surface that will allow some slippage of wheels. Severe damage may result to your vehicle if you engage and operate your vehicle in 4WD on hard surface roadways.

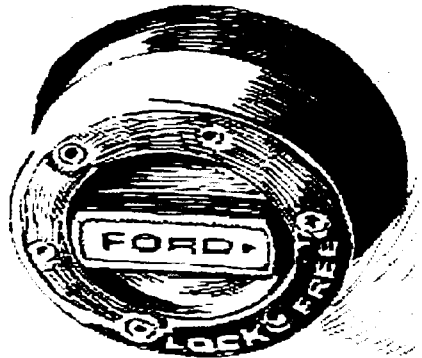
Check the operator's manual for your vehicle prior to using your 4WD system.

Generally 4WD is not that all 4 wheels are spinning to give traction. Usually only one wheel per axle will be pulling.

The tire that is the easiest to turn will get the power from the engine/ drive train.

Manual Hubs

You must physically turn the mechanism to lock in the hubs before 4WD can be engaged. Shift out of 4WD prior to unlocking the hubs.



You may have to "rock" the vehicle to lock-in and unlock hubs. Never use anything other than your hands to turn hubs.

Automatic Hubs

Auto hubs only require you to shift into 4WD. Once you start moving the hubs will engage by themselves. They engage by either vacuum, cam lever, gear mechanism, or springs. Check your vehicle operator's manual.

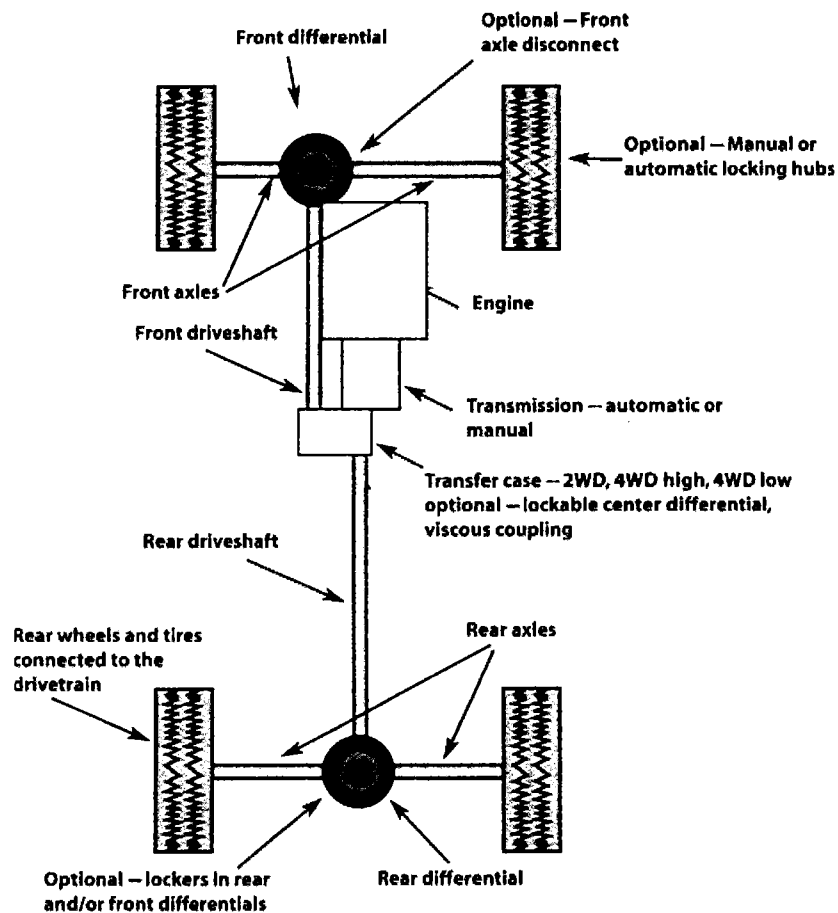
Auto hubs may require you to back up several yards after you shift out of 4WD to disengage the hubs. Read your vehicle operator's manual.

The gear mechanism inside the hubs can be made of plastic, Teflon or metal. These are small parts and can break easily. Limit "rocking" motion of vehicle if you get in a sticky situation.

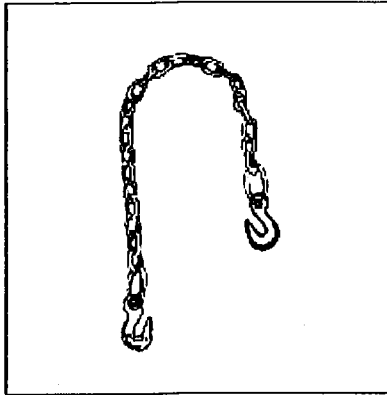
4WD High, which is the same gear ratio of 2WD, allows for higher speeds and vehicle control on dirt roads, slippery, snowy or roads that need a bit more traction.

4WD Low gives a much lower gear ratio for more control on difficult terrain. Most off road driving should be done in low range.

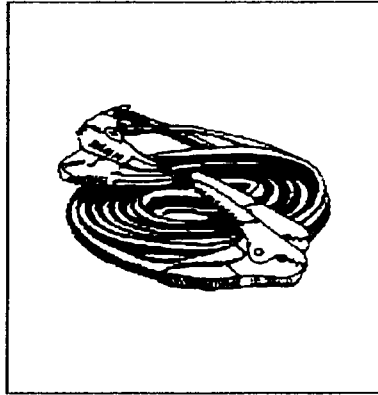
When shifting from 4WD High/Low or Low/High, stop vehicle or decrease speed to less than 2 MPH. If difficulty shifting is experienced, turn off the vehicle and try shifting again.



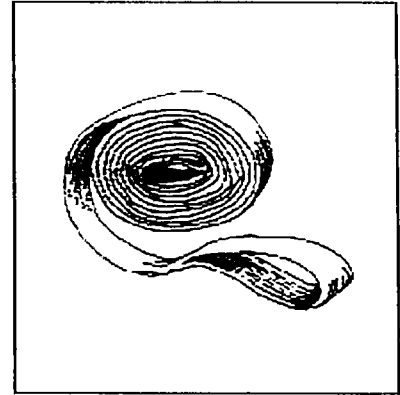
4 Wheel Drive



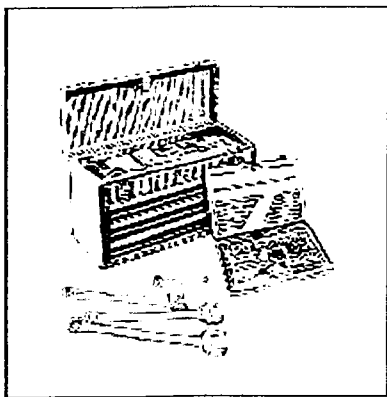
chain with hooks



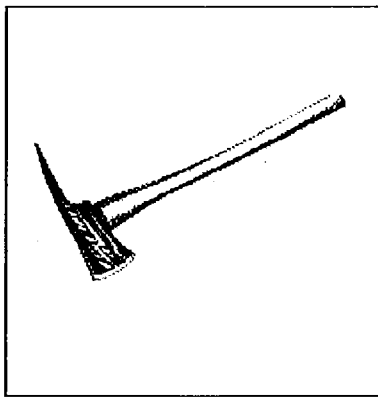
jumper cables



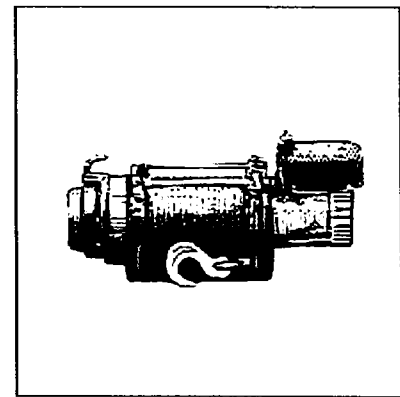
recovery strap



tool kit



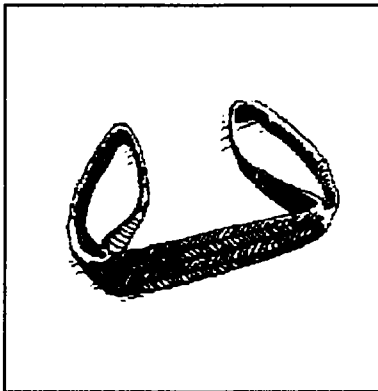
pulaski (or axe)



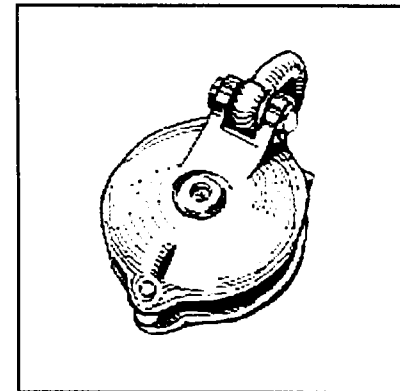
winch



winch accessory kit



tree strap



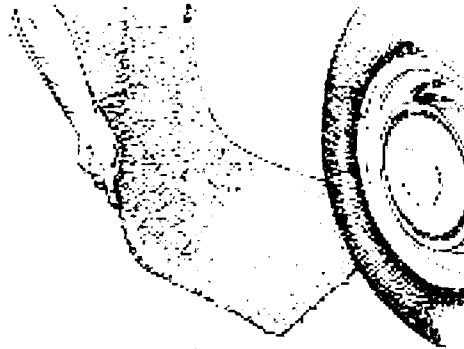
snatch block

Driving through poor traction conditions

Engage 4WD as soon as leaving established roadway. Newer vehicles do not engage as soon as shifted into 4WD. It may take 10 to 30 seconds for the 4WD to engage. If you are waiting until you come to a poor traction condition prior to engaging 4WD you may become stuck before your 4WD engages.

Sand Driving

1. Go/No-Go.
2. Proceed steadily forward, do not spin tires.
3. You may want to reduce tire pressure, possibly down to 10 psi. If you drop tire pressure, make sure to air back up prior to getting on hard surface. Slow speeds, less than 25 m.p.h., for short distances of two to four miles are okay to get to an air source.
4. Stop on a level or down hill area while in sandy soils.
5. Make wide, sweeping turns.
6. Do not spin tires and dig down to frame.
7. You may want to carry 4 strips of carpet to place under tires to keep vehicle from sinking. This spreads pressure and weight of vehicle over greater surface area.



Gravel/Rocks Driving

1. Go/No-Go.
2. Slow speeds.
3. Poor traction.
4. Dust/low visibility.
5. Moguls/bumps may cause loss of control.
6. Rough terrain.
7. Allow suspension to move up and down with terrain by placing tires on level spots and avoiding moguls.
8. If vehicle is empty try softening the tires by letting a few pounds of air out. This gives good traction and better ride.
9. Expect rocks to tumble, logs to roll and soft ground to cause you to slip and slide.
10. Tire placement is very important when driving in rough terrain.
11. Look over hood down road. Do not drive with head out of window, trying to look down at wheels.
12. Keep picture of road in your mind, feel the road as the terrain goes by.
13. Know your undercarriage clearance. Know approach and departure angles.
14. Do not straddle rocks. Place tires on rocks, stumps, etc.

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Basics of Four Wheel Drive

Four Wheel Drive (4WD) offers better traction when in adverse road surface conditions.

Engage 4WD only on road surface that will allow some slippage of wheels. Severe damage may result to your vehicle if you engage and operate your vehicle in 4WD on hard surface roadways.

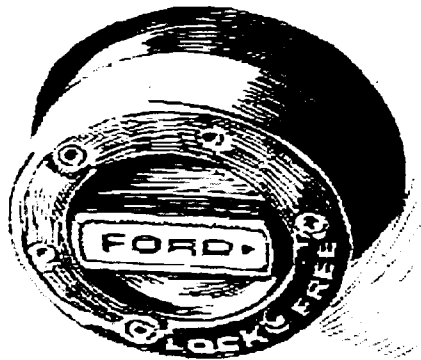
Check the operator's manual for your vehicle prior to using your 4WD system.

Generally 4WD is not that all 4 wheels are spinning to give traction. Usually only one wheel per axle will be pulling.

The tire that is the easiest to turn will get the power from the engine/ drive train.

Manual Hubs

You must physically turn the mechanism to lock in the hubs before 4WD can be engaged. Shift out of 4WD prior to unlocking the hubs.



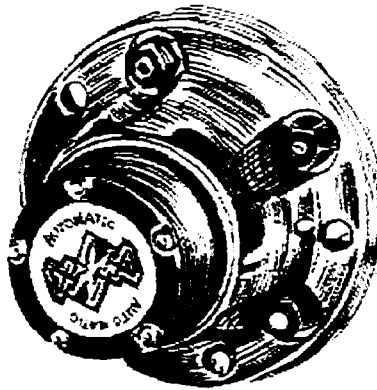
You may have to “rock” the vehicle to lock-in and unlock hubs. Never use anything other than your hands to turn hubs.

Automatic Hubs

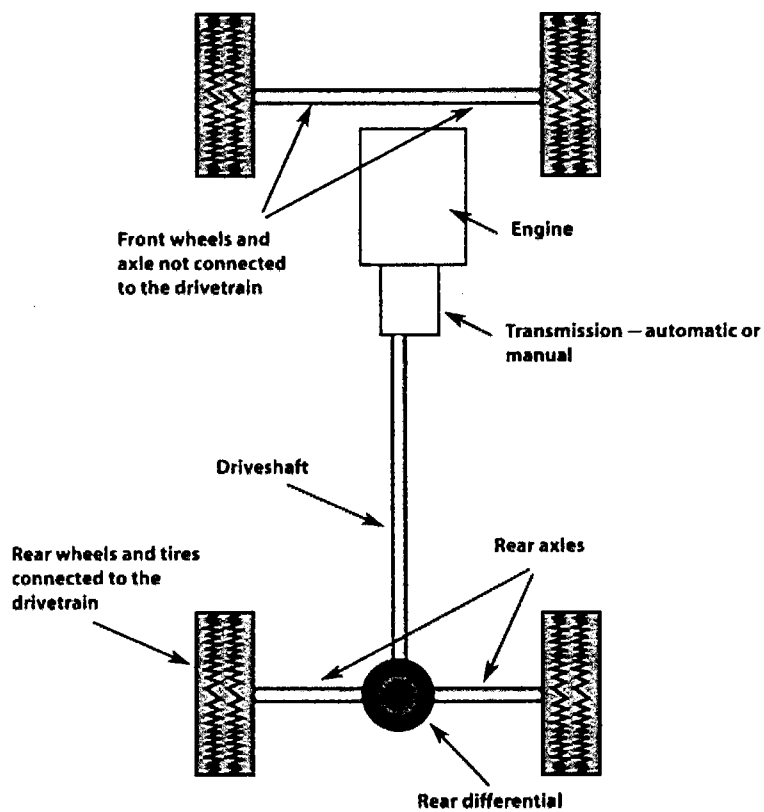
Auto hubs only require you to shift into 4WD. Once you start moving the hubs will engage by themselves. They engage by either vacuum, cam lever, gear mechanism, or springs. Check your vehicle operator's manual.

Auto hubs may require you to back up several yards after you shift out of 4WD to disengage the hubs. Read your vehicle operator's manual.

The gear mechanism inside the hubs can be made of plastic, Teflon or metal. These are small parts and can break easily. Limit “rocking” motion of vehicle if you get in a sticky situation.



Transfer Case (2WD, 4WD Low and 4WD High)



2 Wheel Drive

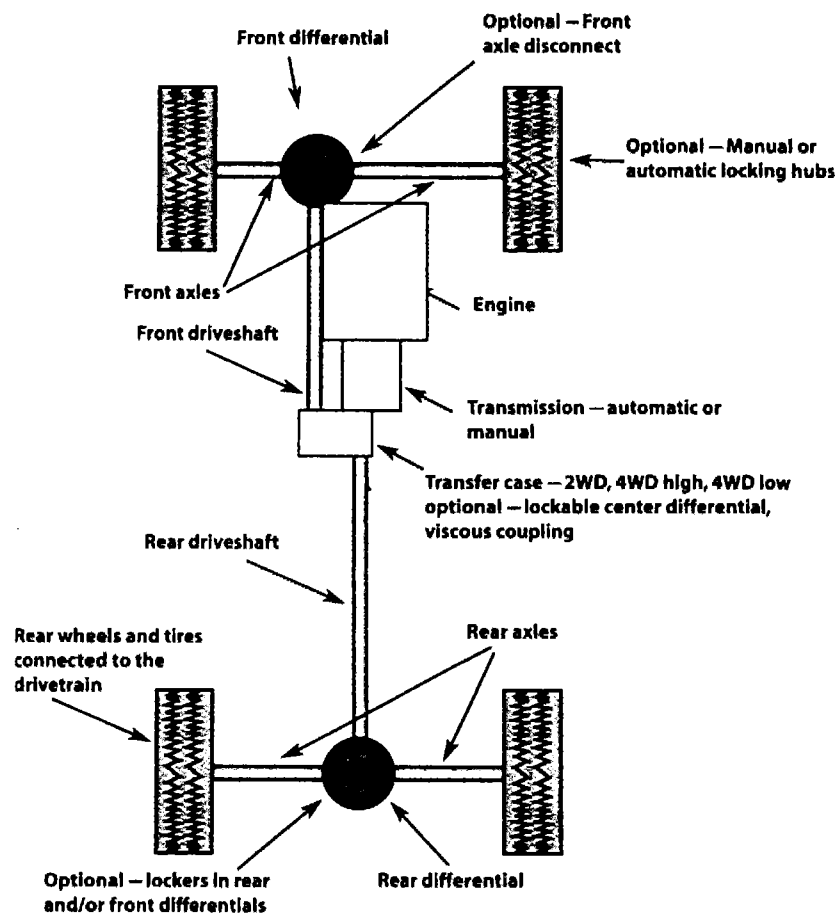
The transfer case causes the power to flow from the engine and transmission, which normally goes to the rear axle but also can go to the front axle (4WD).

In normal road operation the vehicle will be in 2WD. This allows for normal driving on roads and highways.

4WD High, which is the same gear ratio of 2WD, allows for higher speeds and vehicle control on dirt roads, slippery, snowy or roads that need a bit more traction.

4WD Low gives a much lower gear ratio for more control on difficult terrain. Most off road driving should be done in low range.

When shifting from 4WD High/Low or Low/High, stop vehicle or decrease speed to less than 2 MPH. If difficulty shifting is experienced, turn off the vehicle and try shifting again.



4 Wheel Drive

Off-road Driving

Use spotters where appropriate:

- Always use spotter if another person is available;
- Where vision is obstructed or route is uncertain;
- When backing up;

Go/No-Go Checklist

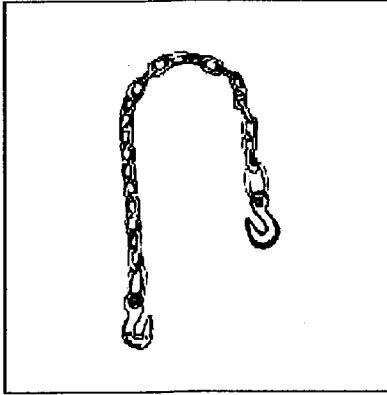
Operator needs to go through a personal Go/No-Go checklist prior to attempting to cross any poor traction or hazardous situations.

Items on the checklist may include:

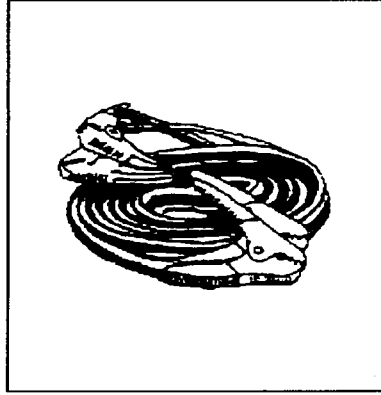
- Can you safely cross this hazard?
- If you cross the hazard once can you return on same path?
- Is there another route you can use that is safer and easier on the environment?
- Do you need to cross at this location?
- If you get stuck or breakdown will you be able to get out of this location without any other assistance?
- Have you scouted the path you are going to take?
- Do you know what is on the other side of the hazard?
- If you decide not to continue what effect will it have on completion of your assignment?
- Does anybody know where you are? Do you have radio or cellular telephone communication?

Tools needed for off-road driving

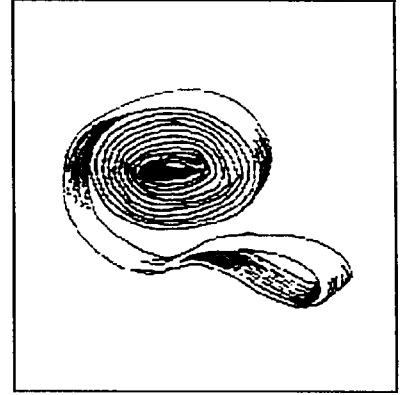
- Shovel
- Chain w/hooks
- Jumper cables
- Recovery strap (3" X 30')
- Tool kit
- Axe or pulaski
- Winch is operational if equipped
- Jack with board to stabilize



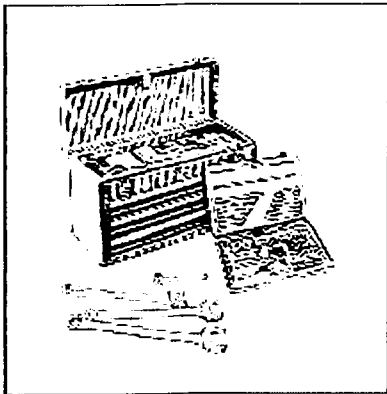
chain with hooks



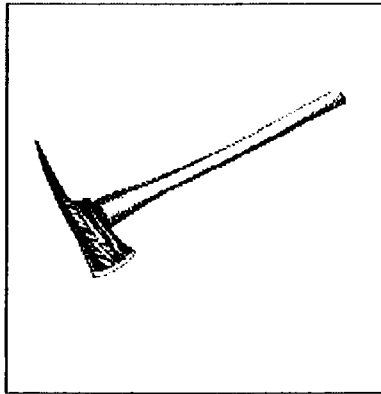
jumper cables



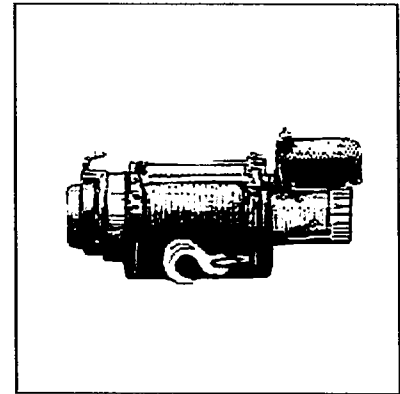
recovery strap



tool kit



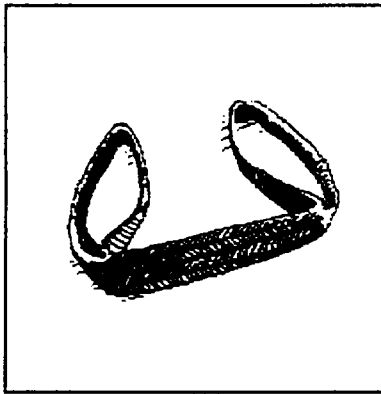
pulaski (or axe)



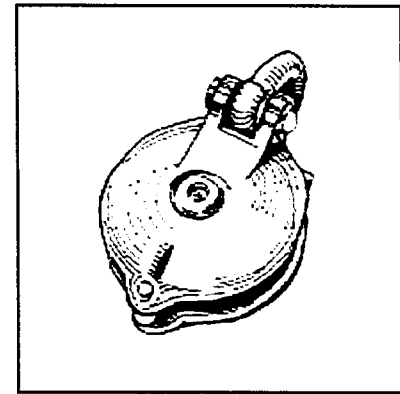
winch



winch accessory kit



tree strap



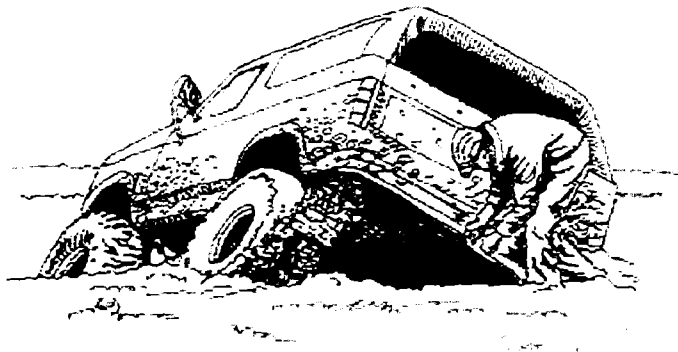
snatch block

Driving through poor traction conditions

Engage 4WD as soon as leaving established roadway. Newer vehicles do not engage as soon as shifted into 4WD. It may take 10 to 30 seconds for the 4WD to engage. If you are waiting until you come to a poor traction condition prior to engaging 4WD you may become stuck before your 4WD engages.

Driving techniques

1. Drive at a slow speed.
2. Minimize the use of sudden acceleration, braking, or turns. They will cause the vehicles center of gravity to shift, destabilizing the vehicle and may lead to a collision or rollover.
3. Maintain steering wheel control at all times. Do not grip the steering wheel spokes. Anticipate steering wheel kickback and keep your fingers and thumbs (monkey grip) on the outside of the steering wheel. Position your hands at 9 and 3 o'clock on the steering wheel.

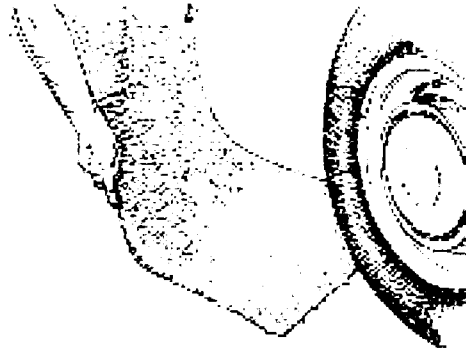


Mud Driving

1. Go/No-Go.
2. Proceed slowly but steadily through mud.
3. Be aware of deep mud holes.
4. Walk and scout difficult section of road to make sure you can get through.
5. Probe mud holes for deep pockets, rocks, roots and other debris.
6. Clean mud hole of debris prior to entering.
7. Expect to slip and slide, do not oversteer.
8. You may want to put on tire chains prior to entering mud hole.
9. Back out before you really get stuck, if possible.
10. Remember to clean undercarriage and inspect drive train.
11. If forward progress is slowed try turning wheels back and forth quickly to transfer torque from one tire to another.

Sand Driving

1. Go/No-Go.
2. Proceed steadily forward, do not spin tires.
3. You may want to reduce tire pressure, possibly down to 10 psi. If you drop tire pressure, make sure to air back up prior to getting on hard surface. Slow speeds, less than 25 m.p.h., for short distances of two to four miles are okay to get to an air source.
4. Stop on a level or down hill area while in sandy soils.
5. Make wide, sweeping turns.
6. Do not spin tires and dig down to frame.
7. You may want to carry 4 strips of carpet to place under tires to keep vehicle from sinking. This spreads pressure and weight of vehicle over greater surface area.



Gravel/Rocks Driving

1. Go/No-Go.
2. Slow speeds.
3. Poor traction.
4. Dust/low visibility.
5. Moguls/bumps may cause loss of control.
6. Rough terrain.
7. Allow suspension to move up and down with terrain by placing tires on level spots and avoiding moguls.
8. If vehicle is empty try softening the tires by letting a few pounds of air out. This gives good traction and better ride.
9. Expect rocks to tumble, logs to roll and soft ground to cause you to slip and slide.
10. Tire placement is very important when driving in rough terrain.
11. Look over hood down road. Do not drive with head out of window, trying to look down at wheels.
12. Keep picture of road in your mind, feel the road as the terrain goes by.
13. Know your undercarriage clearance. Know approach and departure angles.
14. Do not straddle rocks. Place tires on rocks, stumps, etc.



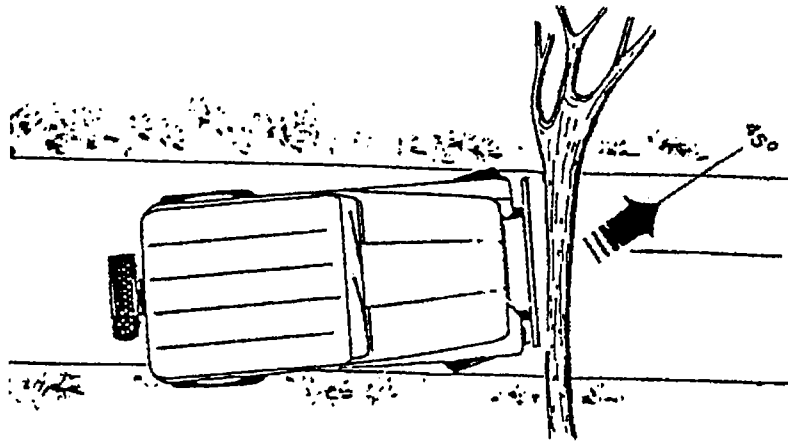
15. Speed on rough terrain 5 to 10 m.p.h.
16. Keep vehicle as level and even as possible.
17. Use spotter.



Gullies/ditches/logs/windfall and culverts

1. Go/No-Go
2. Scout route first if uncertain.
3. Cross at a diagonal/45 degree angle when possible.
4. This increases clearance and traction.
5. Proceed slowly.
6. Use spotter.
7. Ease in and power out.

8. Allow one tire at a time to cross obstacle while the other three help push and pull the other over.



9. Small gullies can be approached at less than 2 m.p.h. in first gear, 4-wheel drive, at right angle using foot brake to ease front wheels into and over the gully.
10. Whenever possible move logs, cut with axe or chainsaw or drag away.
11. If necessary, fill in with rocks, brush, dirt and wet down to solidify the aggregate before starting over.
12. Watch for branches, broken pieces, etc. kicking up and causing damage to the body parts or getting caught in drive train.
13. When traveling a road with gullies straddle "V" groove. If groove gets too wide you will have to drive down into gully. Keep vehicle as level as possible and centered over gully.





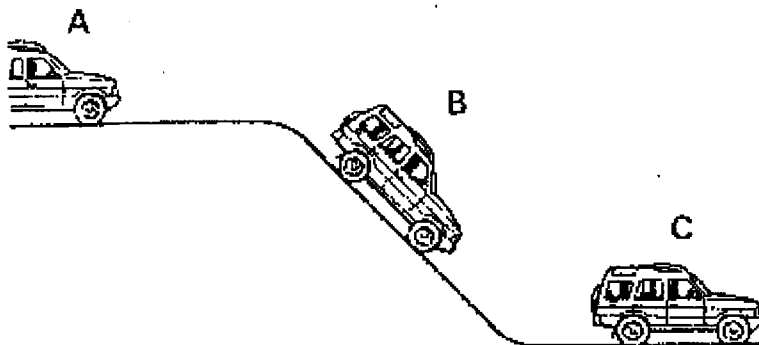
Side Hills

1. Go/No-Go
2. Avoid whenever possible
3. Vehicle with high center of gravity
4. Less traction/control of vehicle
5. Scout route
6. Use spotter
7. Proceed slowly but steadily
8. Avoid stumps and rocks on uphill side.
9. Watch for downhill holes, or uphill rocks and stumps that could exceed tilt degree.
10. Do not overreact. Vehicles tend to slide before they roll. If vehicle slides, stop-- then figure out easiest and quickest way to level surface.
11. Keep tires straight, do not turn uphill unless to follow tracks.
12. Stay on established roadways.
13. Do not turn around on side hill. Back vehicle down to level surface.
14. Do not attempt to side hill with high profile vehicle.
15. Avoid steep terrain
16. If the vehicle becomes unstable, steer downhill



Climbing Hills

1. Go/No-Go
2. Scout route for hazards
3. Avoid deep ruts
4. Watch for hidden objects
5. Scout for a turn around spot on top of the hill
6. Evaluate surface conditions
7. Estimate slope
8. Drive straight uphill
9. Low range 4WD
10. Start out in low gear
11. Slow and steady
12. Don't spin tire
13. Just enough power to get up hill
14. Avoid shifting gears on the hill



Descending Hills

1. Go/No-Go
2. Scout route for hazards
3. Avoid deep ruts
4. Watch for hidden objects
5. Beware of a dead end at bottom, nowhere to go
6. Scout for a turn around spot
7. Estimate slope
8. Proceed slowly
9. Do not gun the engine. Gunning the engine can cause the wheels to spin and lead to a loss of traction.
10. Go straight down hill
11. Use gentle acceleration to avoid sliding
12. Low range 4WD
13. Use lowest gear for maximum engine braking effect
14. Easy on brakes, just enough to maintain desired speed and control. Rapid pumping of the brakes will slow the vehicle and still maintain steering control.
15. If you sense a loss of traction, turn the steering wheel rapidly from side-to-side. This may provide additional traction.

Negotiate Water Hazards

1. Go/No-Go
2. Scout route
3. Use a spotter
4. Determine water depth



5. Cross where others have crossed

6. Stream bed is:
 - a. Rock and gravel
 - b. Boulders
 - c. Mud or sand
7. The possibility of vehicle engine swallowing water exists. Note location of engine air intake is during inspection.
8. If possible do not go into water or mud over top of tires.
9. Make sure you can get out of other side and current is not too swift.
10. Once out, remember brakes are wet and give them time to dry out. You may apply light pressure to brakes to help them dry out faster.
11. If vehicle stalls in water and possibly swallows water do not restart engine as this could damage it. Remove vehicle from water using recovery methods, winching, pulling or pushing.
12. Take care to minimize damage and disturbance to stream bank and bed.

Negotiate brush, trees, etc., w/o damaging vehicles.

1. Go/No-Go
2. Use spotters
3. Proceed slowly
4. Scout route
5. Engage 4WD
6. Special hazards

Snow/Ice

1. Go/No-Go
2. Determine depth of snow
3. Know your undercarriage clearance
4. Proceed slowly but steadily through snow
5. Avoid sudden braking, acceleration, and steering
6. Walk and scout difficult section of road to make sure you can get through.
7. Expect to slip and slide, do not oversteer
8. Use engine braking effect to slow vehicle
9. You may want to put on tire chains prior to entering snow. Chains are essential on icy terrain.
10. Back out before you really get stuck, if possible.
11. Remember to clean undercarriage and inspect drive train.
12. If forward progress is slowed try turning wheels back and forth quickly to transfer torque from one tire to another.
13. Avoid steep slopes

If your vehicle becomes stuck

1. Do not gun the engine. That will cause the vehicle to sink deeper.
2. You may be able to rock the vehicle out by shifting from forward and reverse gears, stopping between shifts, in a steady pattern. Press lightly on the accelerator in each gear.
3. Use safe winching techniques

Post trip inspection

After returning to hard surface check vehicle:

1. Disengage 4WD
2. Rock between dual tires
3. Damage to body
4. Damage to undercarriage
5. Leaking fluids
6. Tire damage
7. Debris in undercarriage
8. Hanging wires

Stopping and Re-Starting on a Steep Incline

Standard Transmission

1. Use emergency brake to hold vehicle.
2. Put vehicle in lowest gear (4 low should be used).
3. Lift clutch until it tries to engage using idle of motor only. Do not lift all the way (like riding the clutch). This will feel like the vehicle wants to move forward. Hold the clutch in this position.
4. Take foot off the brake pedal.
5. As the clutch engages, and starts to move the vehicle forward, release the emergency brake and lift clutch slowly.
6. The vehicle will move in idle.
7. Then increase RPM. **SLOWLY...**

Automatic Transmission

1. Use emergency brake to hold vehicle.
2. Put vehicle in lowest gear (4 low should be used).
3. Press the accelerator until the transmission tries to engage (without using the brake pedal). This will feel like the vehicle wants to move forward.
4. As the transmission engages and starts to move the vehicle forward, release the brake.
5. As the vehicle moves increase the engine RPM.
6. This procedure will put less stress on running gears and drive train.

S-216

Driving for the Fire Service

Off Road Driving

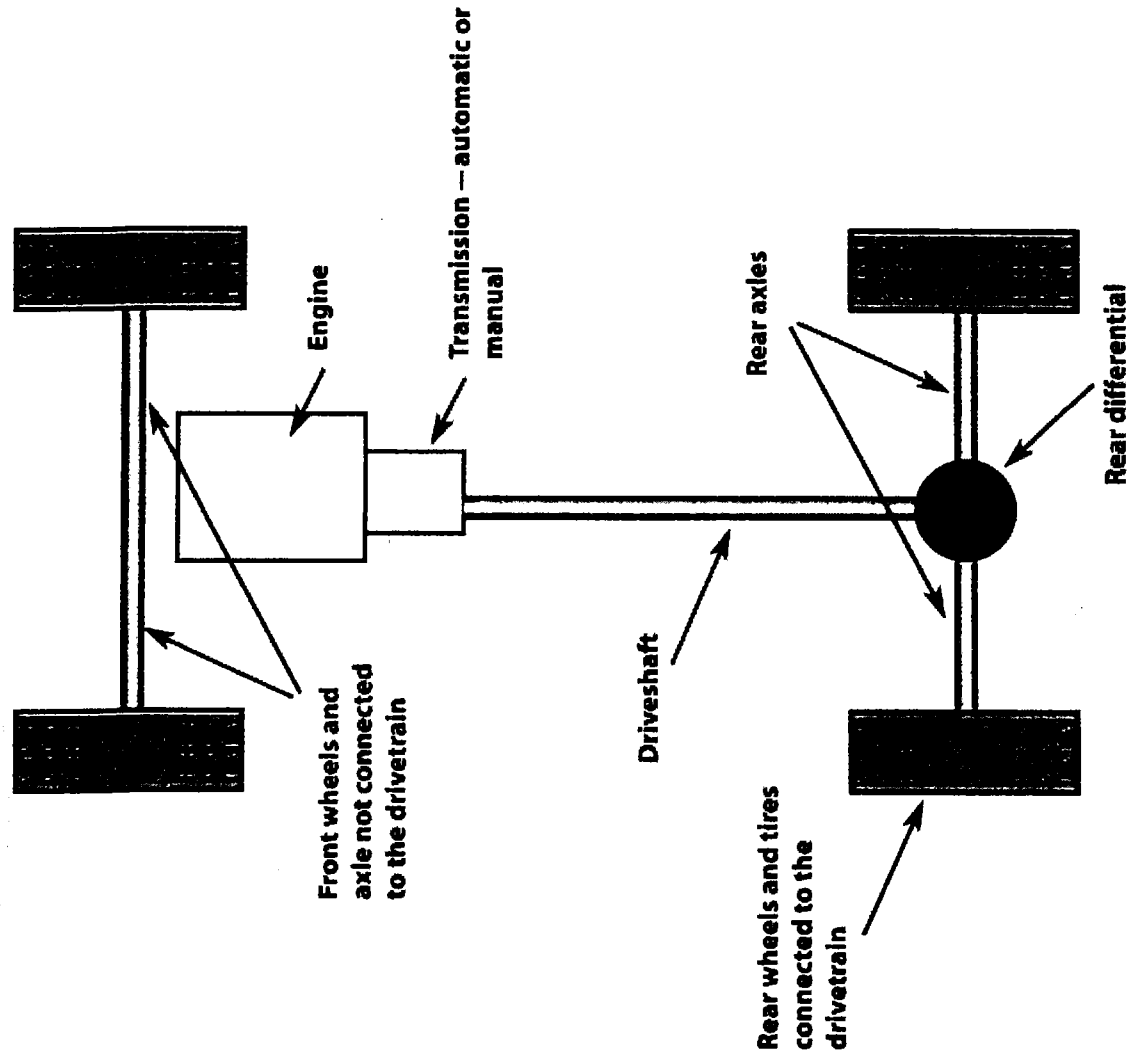


06-1-S215-EP

Objectives

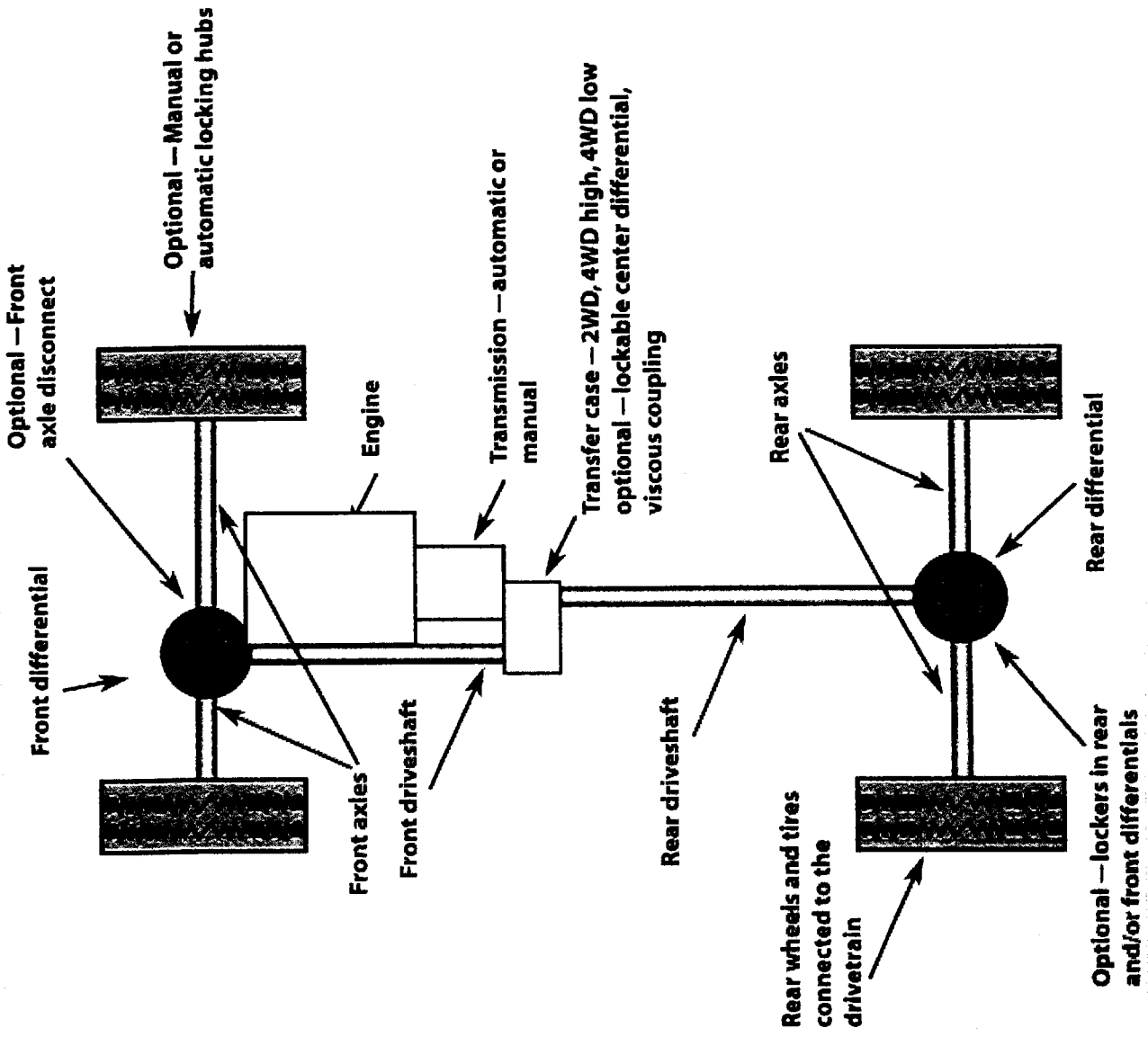
- 1. Identify off-road hazards.**
- 2. Review the Go/No Go Checklist.**
- 3. List 5 tools needed when traveling off road.**

Typical 2-wheel drive drivetrain



06-3-S215-EP

Typical 4-wheel drive drivetrain



Off Road Driving Procedures

Use spotters where appropriate.

- **Always use spotter if another person is available.**
- **Where vision is obstructed or route is uncertain**
- **When backing up**
- **Make sure vehicle operator can see spotter at all times.**
- **Operator and spotter need to be able to communicate either orally or by hand signals.**

Go/No Go Checklist

1. Can you safely cross this hazard?
2. If you cross the hazard once can you return on same path?
3. Is there another route you can use that is safer and easier on the environment?

Go/No Go Checklist

4. Do you need to cross at this location?
5. If you get stuck or break down will you be able to get out of this location without any other assistance?
6. Have you scouted the path you are going to take?

Go/No Go Checklist

7. Do you know what is on the other side of the hazard?
8. If you decide not to continue what effect will it have on completion of your assignment?
9. Does anybody know where you are? Do you have radio or cellular telephone communication?

Tools Needed for Off Road Driving

- A. Shovel
- B. Chain w/hooks
- C. Jumper cables
- D. Recovery strap
- E. Tool kit



06-9-S215-EP

Hand placement



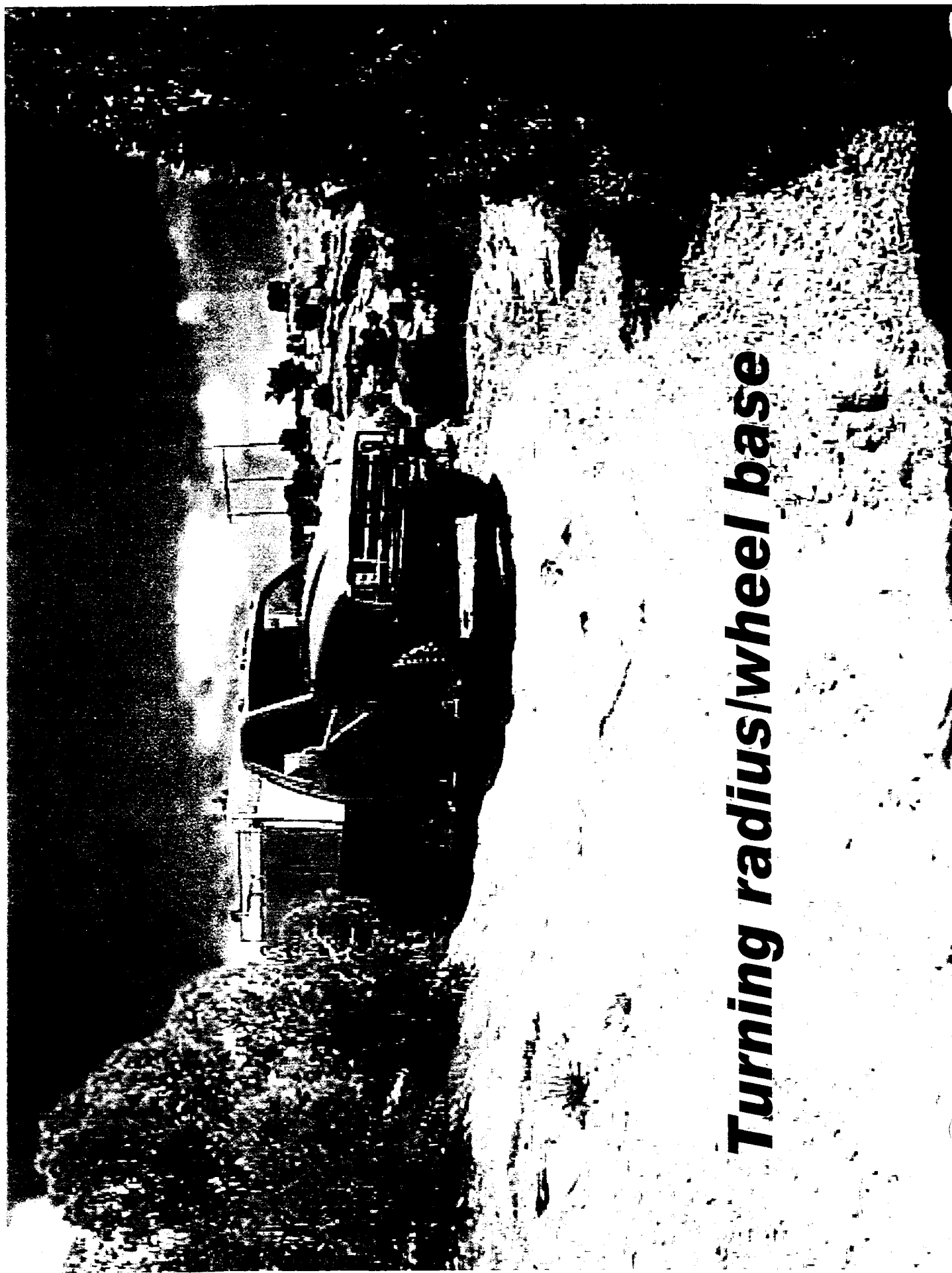
On steering wheel, place hands at the 9 and 3 o'clock position.

- Thumbs on outside of wheel.**

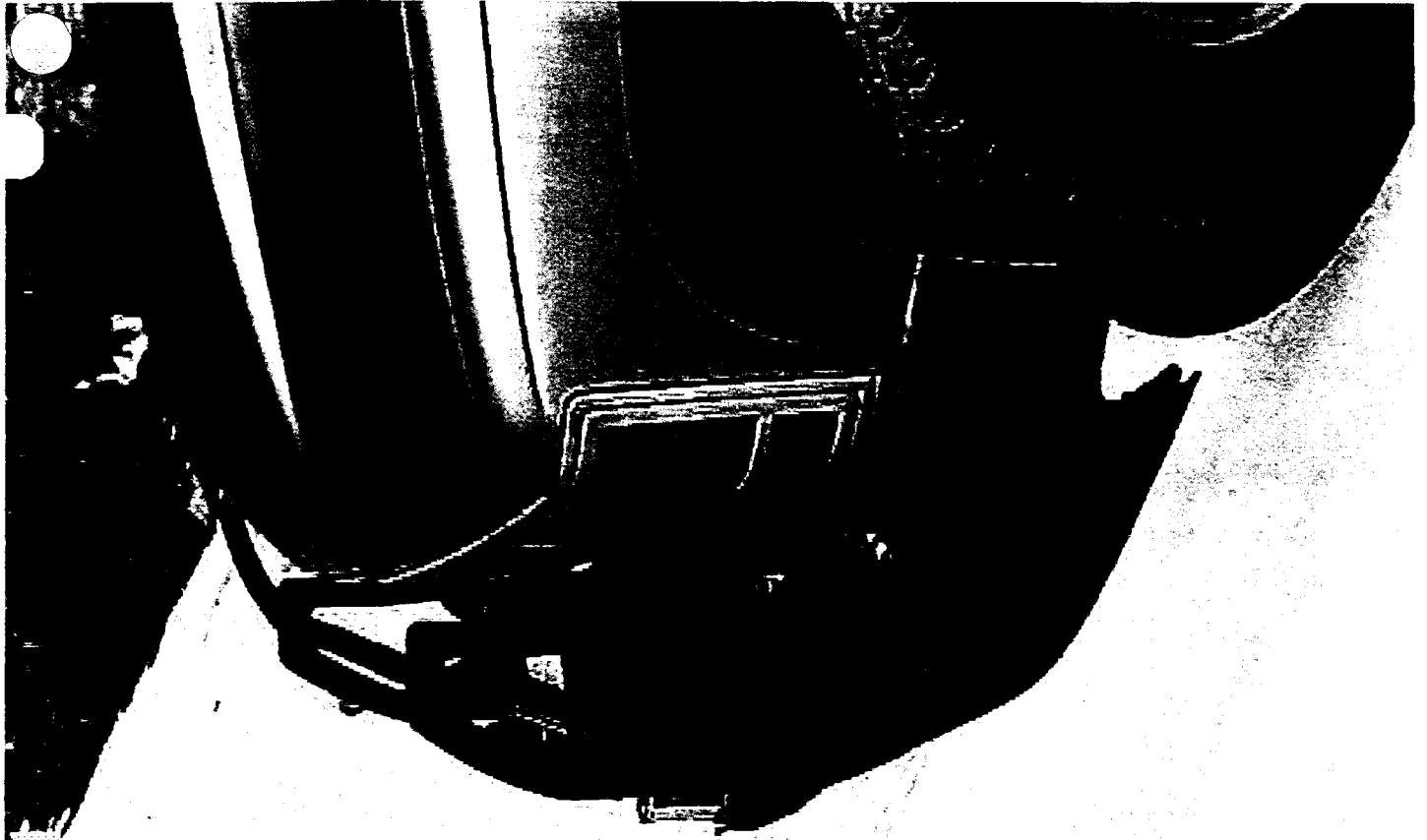
are- High Center of Gravity



03-11-16-16EP



Turning radius/wheel base



Ground Clearance

Tire Placement on Rocks



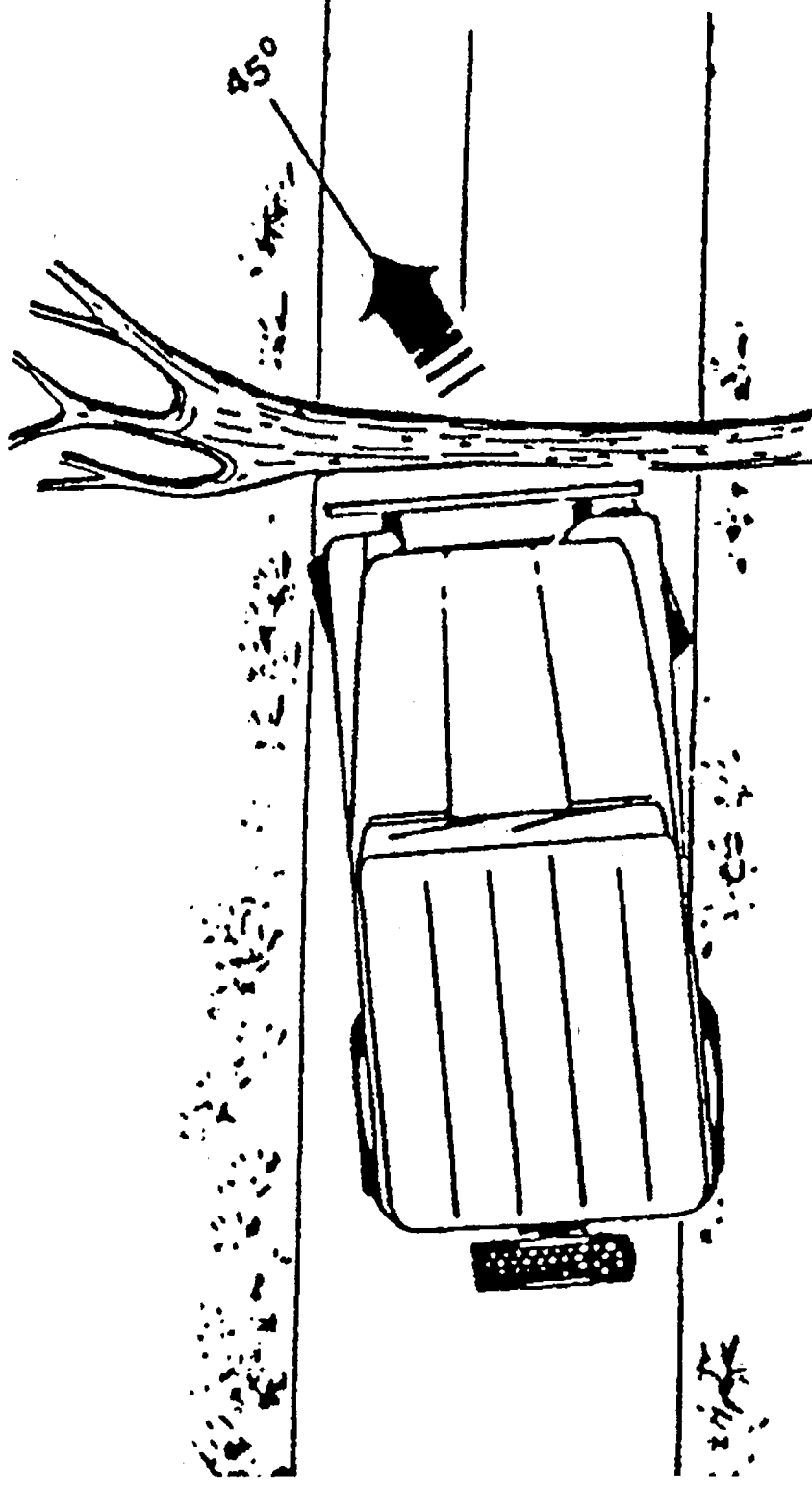
06-14-S215-EP

Gullies/ditches/logs/windfalls and culverts

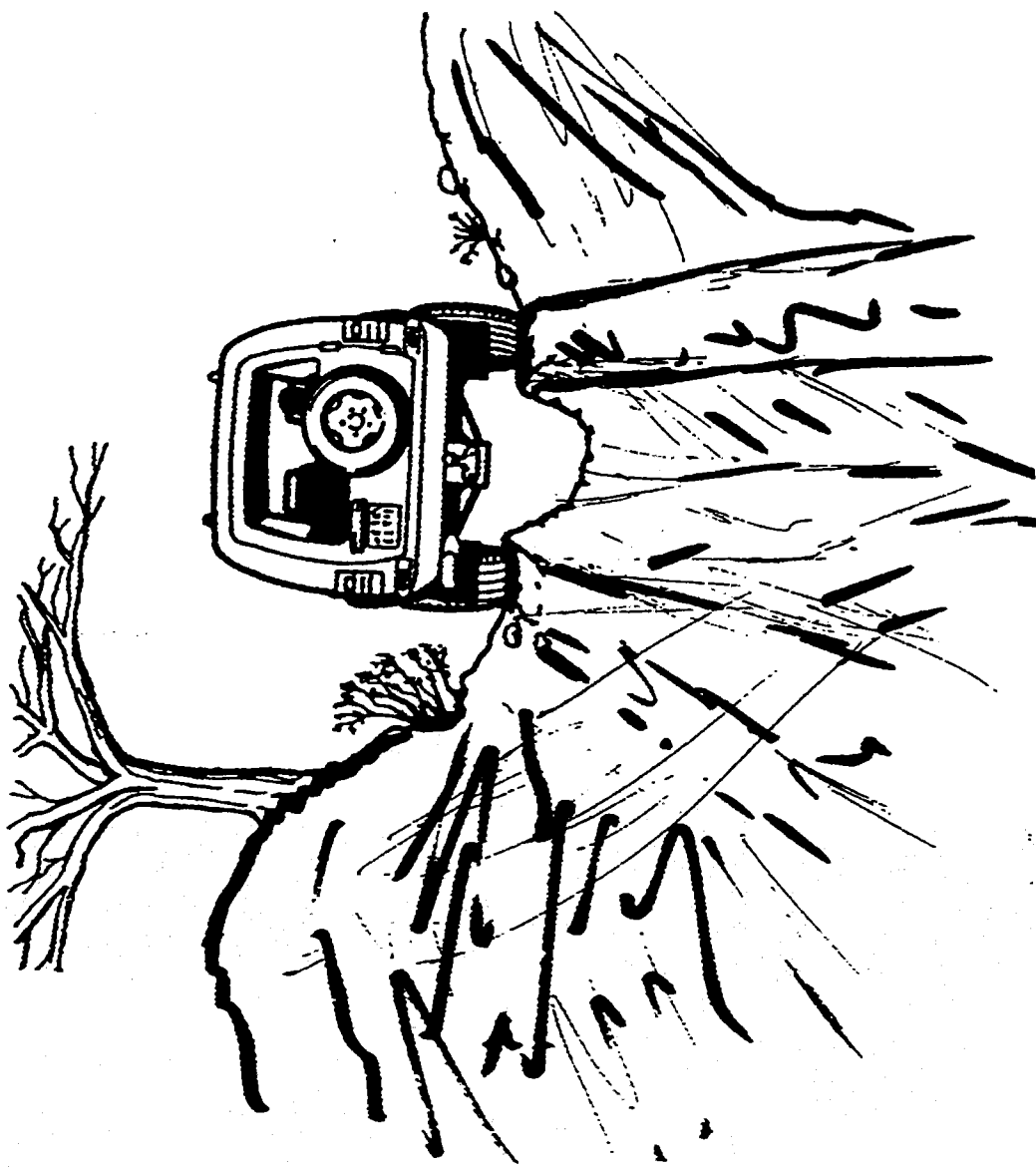


06-15-S215-EP

Gullies/ditches/logs/windfalls and culverts



06-16-S215-EP



Straddle the "V" groove in gullies.

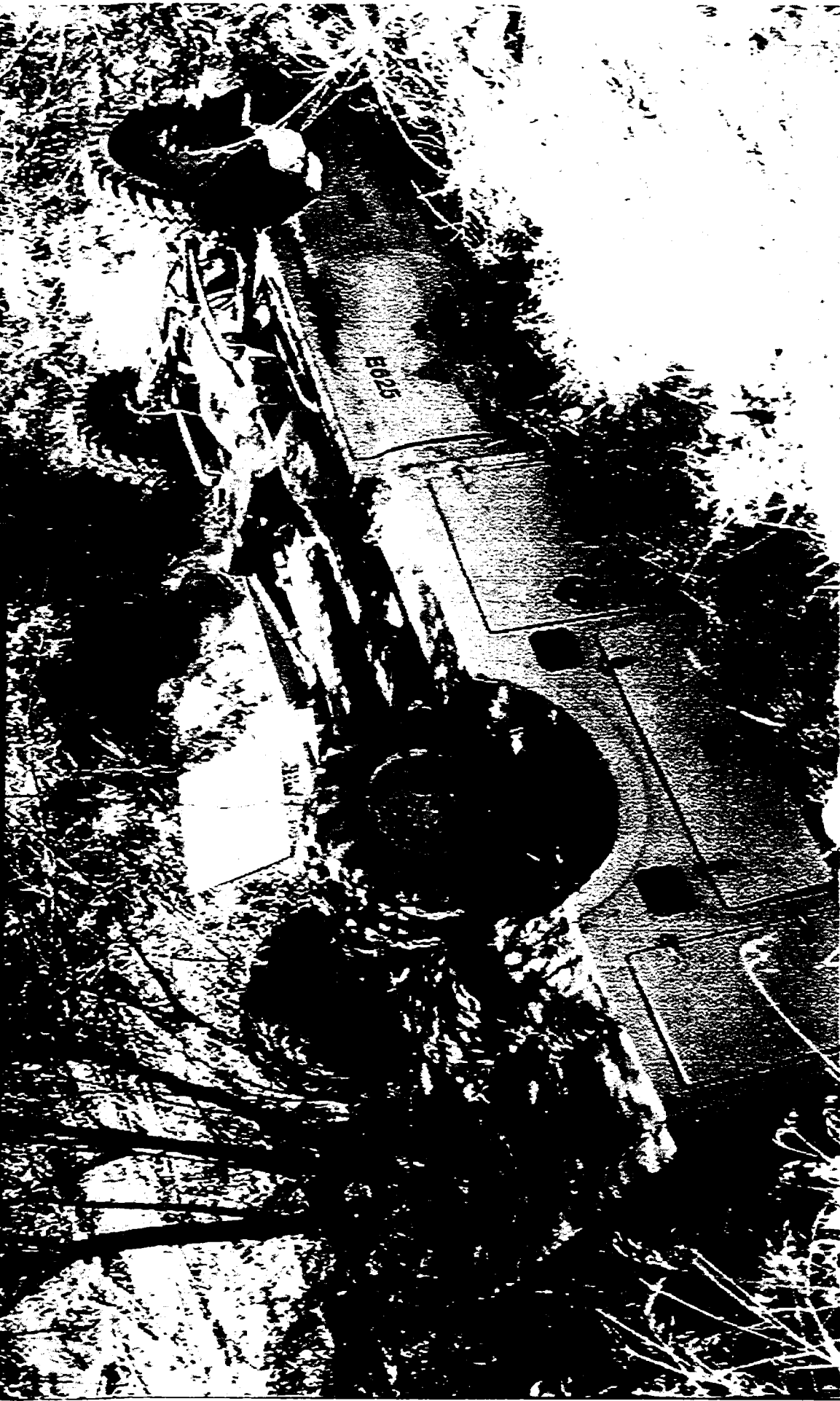
06-17-S215-EP

DRIVING THROUGH POOR TRACTION CONDITIONS

Side hills

- Avoid whenever possible
 - Vehicle with high center of gravity
 - Less traction/control of vehicle
- Scout route
 - Use spotter
 - Avoid stumps and rocks with uphill tires.
 - Avoid placing downhill tires in holes.

Avoid side hill driving!



06-19-S215-EP

DRIVING THROUGH POOR TRACTION CONDITIONS

CLIMBING HILLS

- **Go/No-Go**
- **Scout route for hazards.**
- **Deep ruts**
- **Hidden objects**
- **Turn around spot on top**
- **Surface conditions**
- **Estimate slope**

DRIVING THROUGH POOR TRACTION CONDITIONS

Climbing hills

- **Drive straight uphill.**
- **Low range 4WD**
- **Start out in low gear.**
- **Slow and Steady**
- **Don't spin wheels.**
- **Just enough power to get up the hill**

DRIVING THROUGH POOR TRACTION CONDITIONS

Descending Hills

- Go/No-Go
- Scout route for hazards.
- Deep ruts
- Hidden objects
- Dead end at bottom. No where to go.
- Turn around spot
- Estimate slope

Downhill Driving

06-23-S215-EP

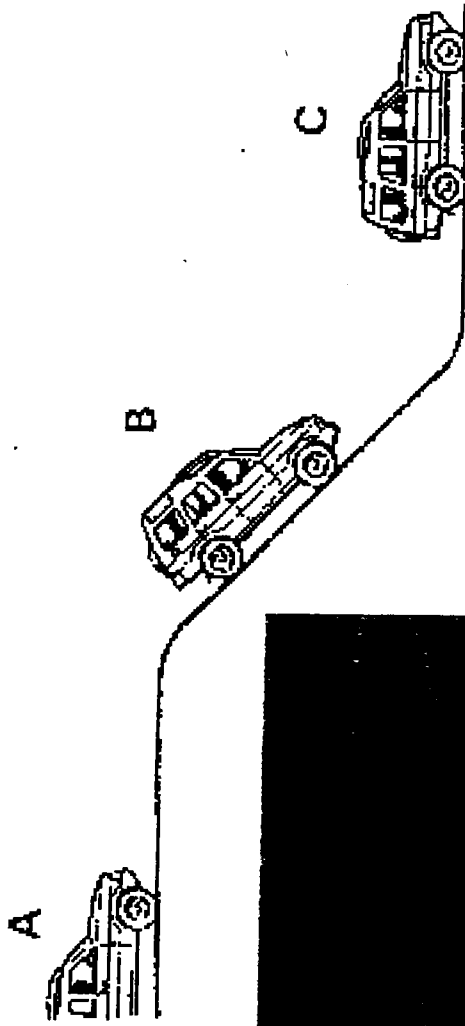
DRIVING THROUGH POOR TRACTION CONDITIONS

Descending Hills

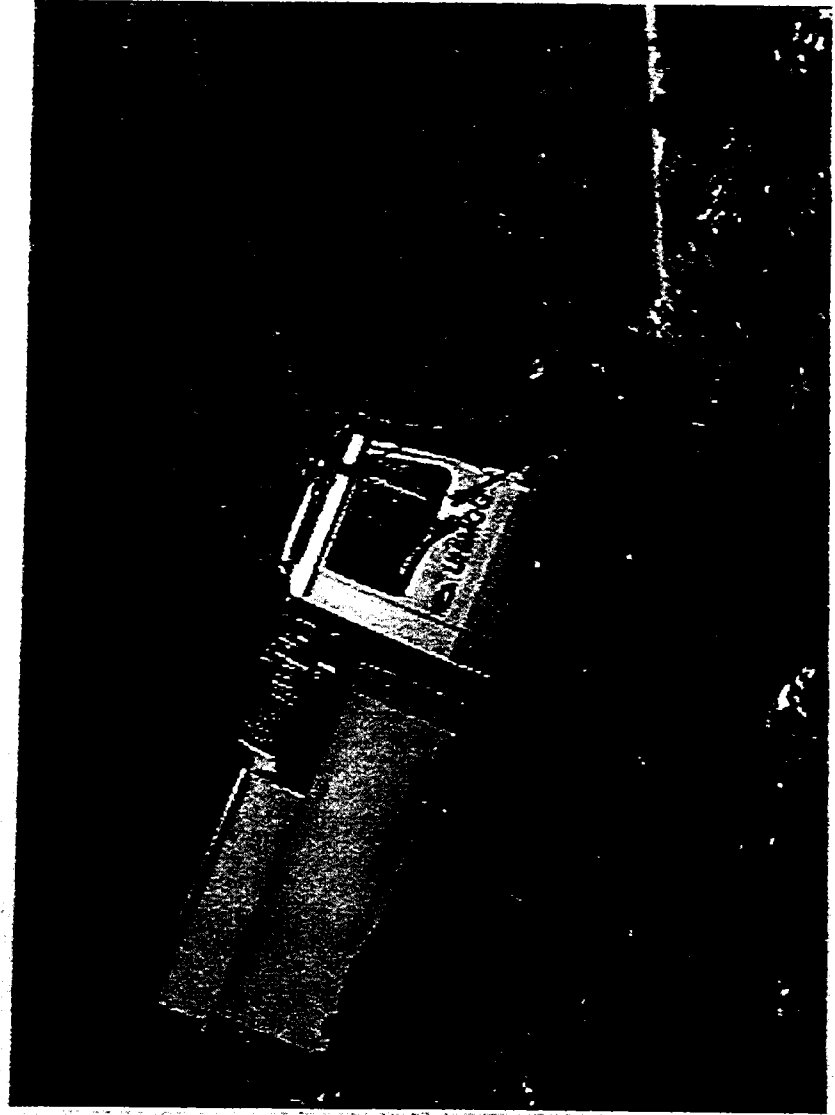
- Go straight downhill.
- Low range 4WD
- Easy on the brakes, just enough to maintain desired speed and control.

Descending Hills

On steep descents keep braking to a minimum. Keep the rear end from coming around by using light throttle.



- A. Stop; shift into first gear low range.
- B. Engine compression; stay off the brakes, stay off the clutch.
- C. Follow through with light throttle. Keep the front end from compressing, causing bottoming out.



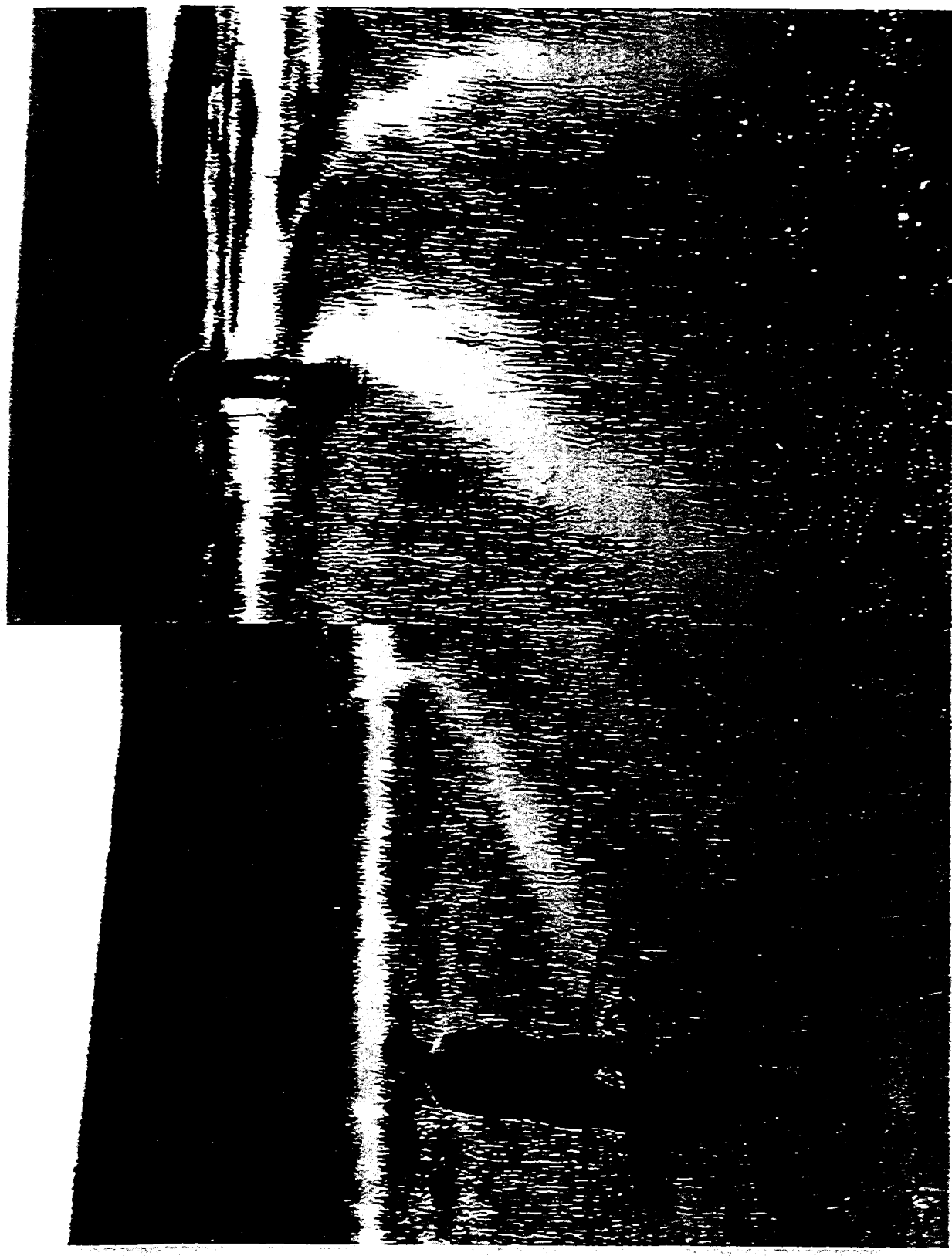
06-25-S215-EP

DRIVING THROUGH POOR TRACTION CONDITIONS

Negotiate water hazards

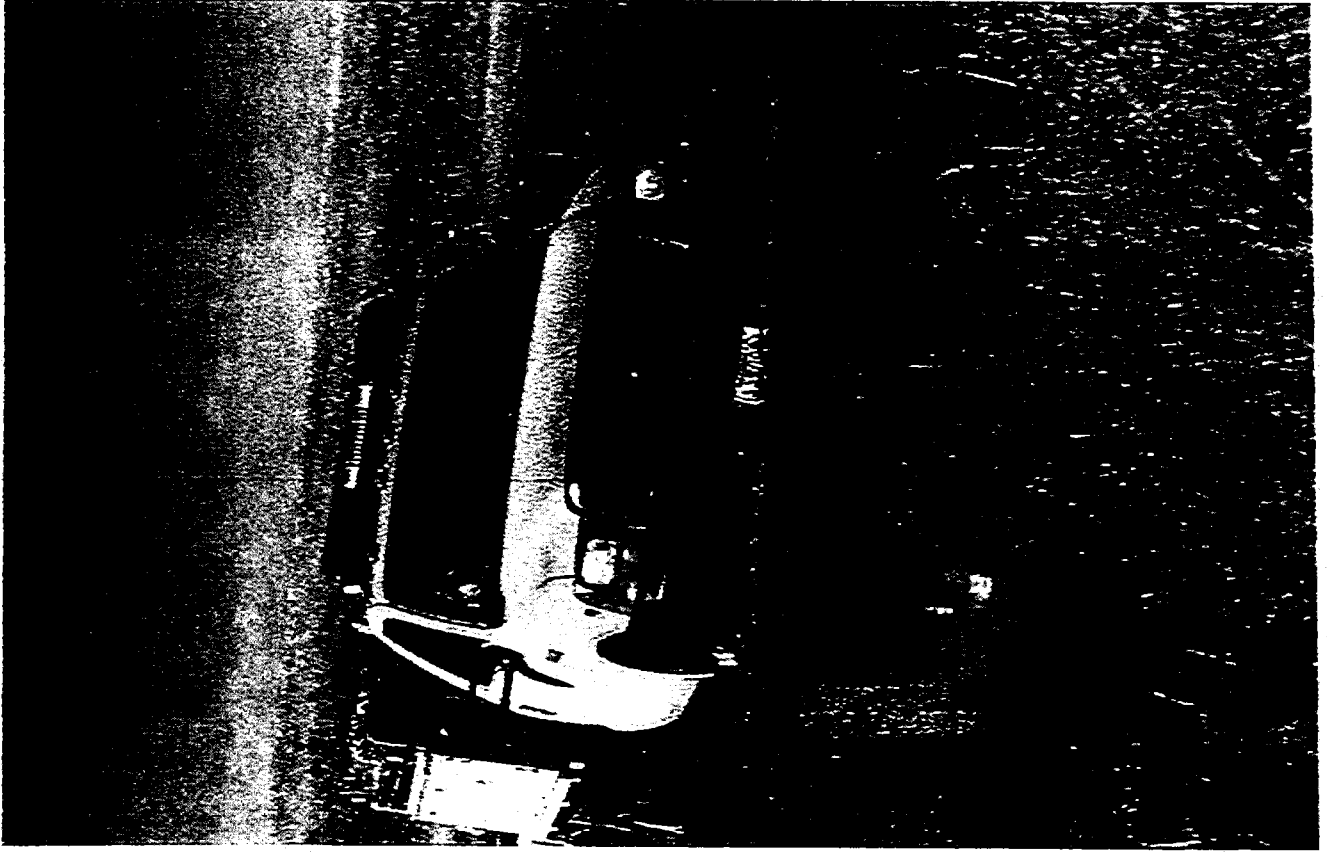
- Go/No-Go
- Water depth
- Cross where others have crossed.
- Stream bed
 - Rock and gravel
 - Boulders
 - Mud or sand
- Use spotter

Scout route for hazards



06-27-S215-EP

WATER HAZARDS



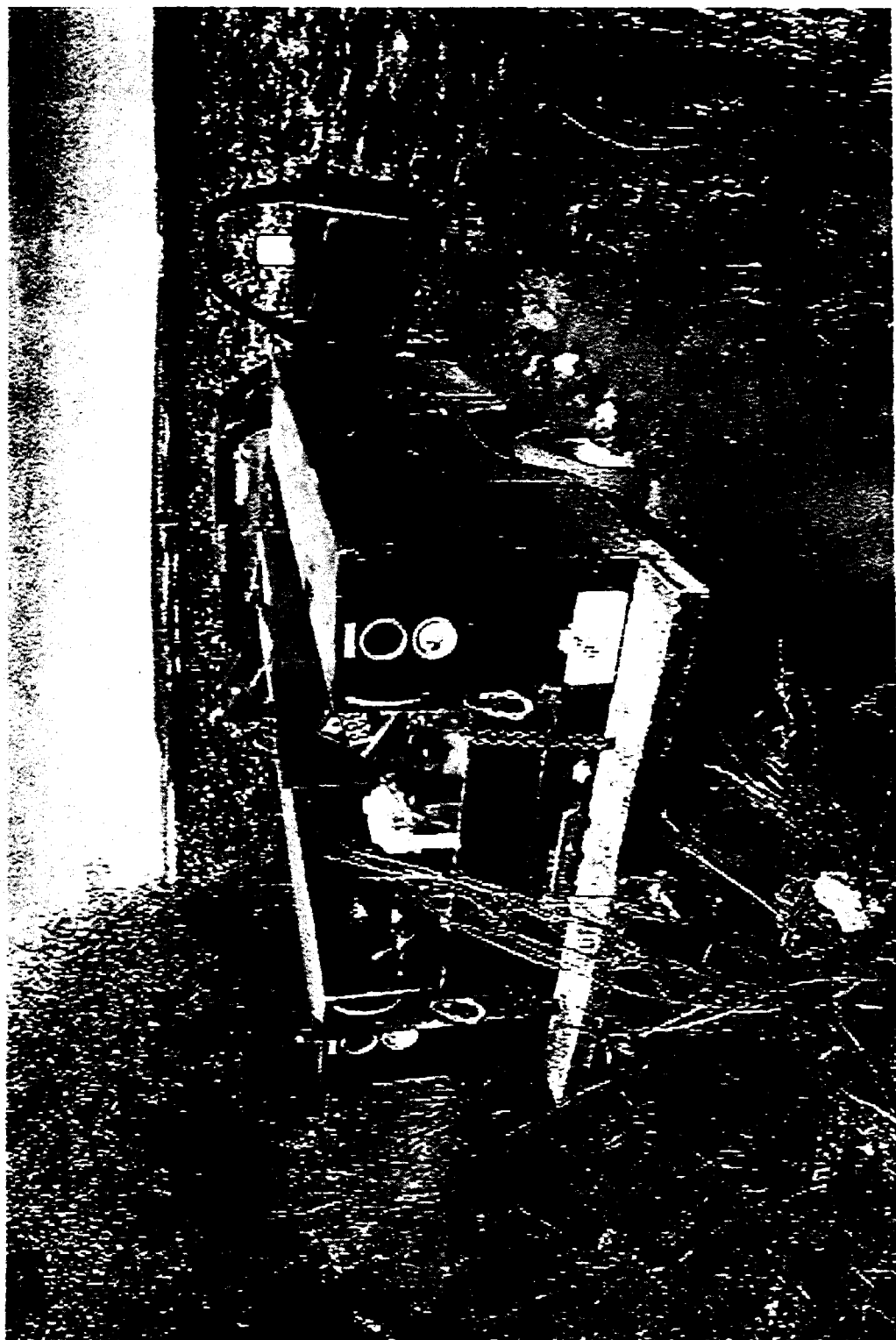
06-28-S215-EP

Sand



06-29-S215-EP

Mud



06-30-S215-EP



Brakes Checked?

06-31-S215-EP

DRIVING THROUGH POOR TRACTION CONDITIONS

**Negotiate brush & trees, without
damaging vehicle.**

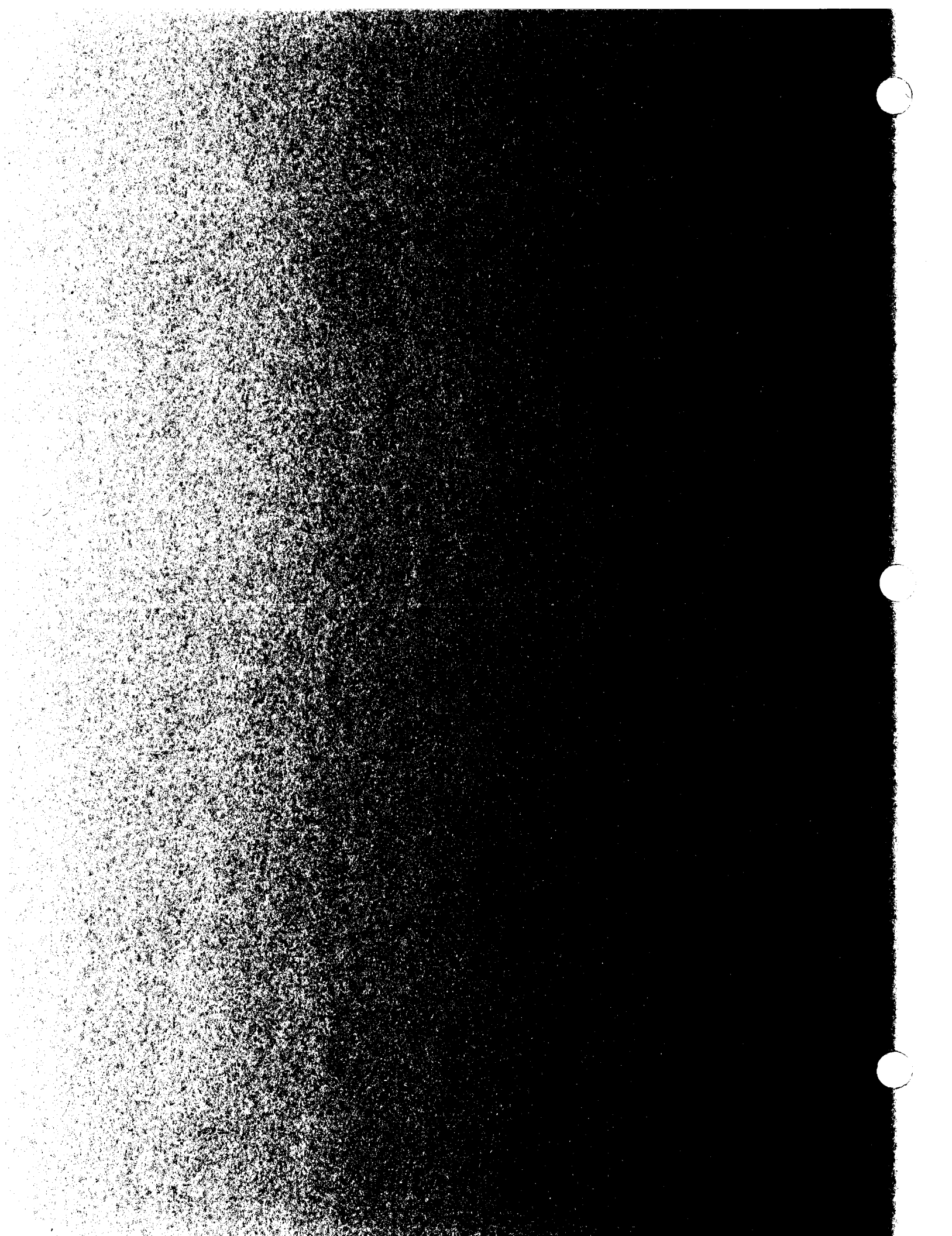
- **Go/No-Go**
- **Use spotter**
- **Proceed slowly**
- **Scout route**
- **Engage 4WD**

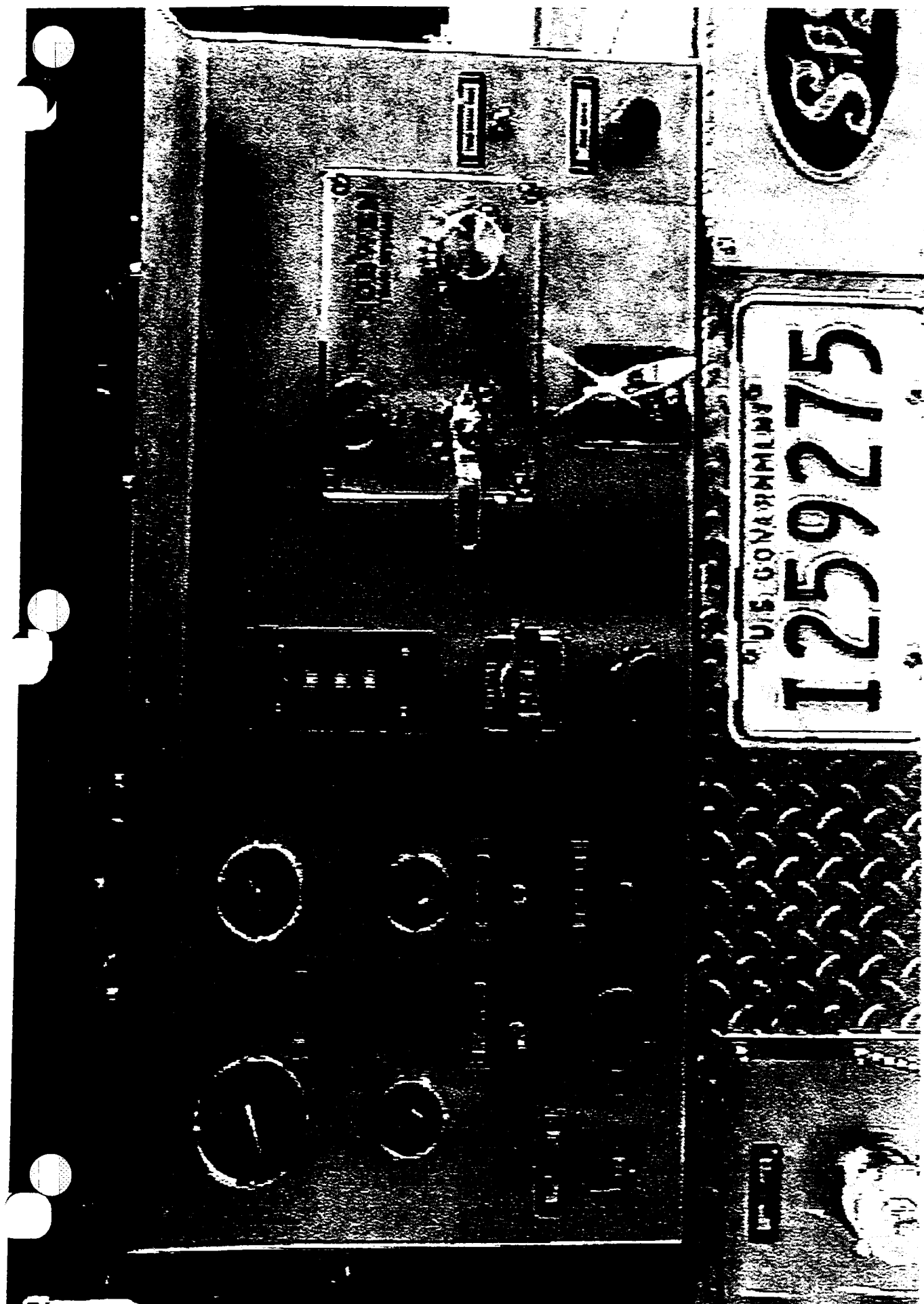
POST TRIP INSPECTION

- 1. Disengage 4WD**
- 2. Rock between dual tires**
- 3. Damage to body**
- 4. Damage to undercarriage**

POST TRIP INSPECTION

- 5. Leaking fluids**
- 6. Tire damage**
- 7. Debris in undercarriage**
- 8. Hanging wires**
- 9. Any others?**



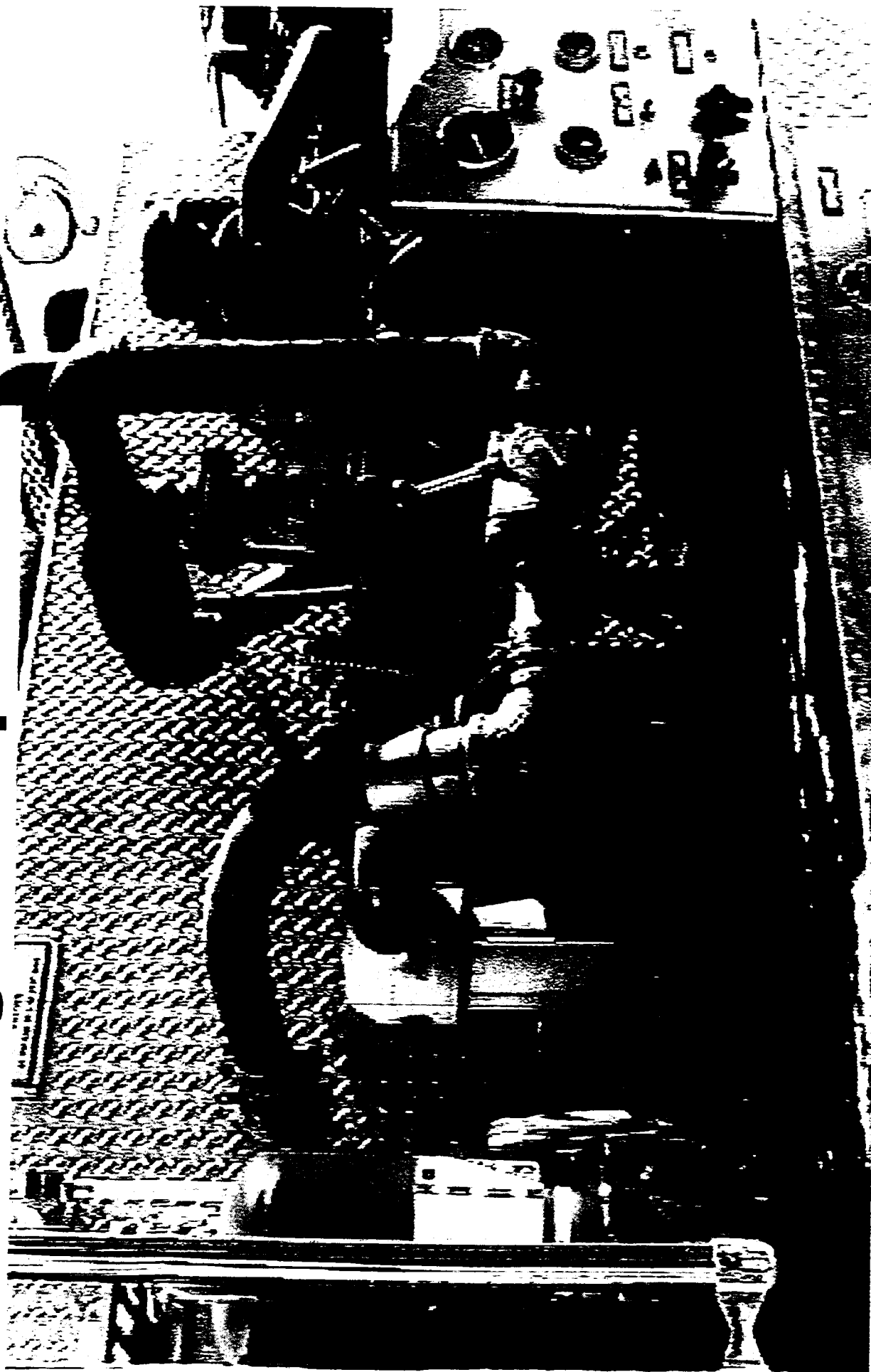


2-1-ENOP-PP

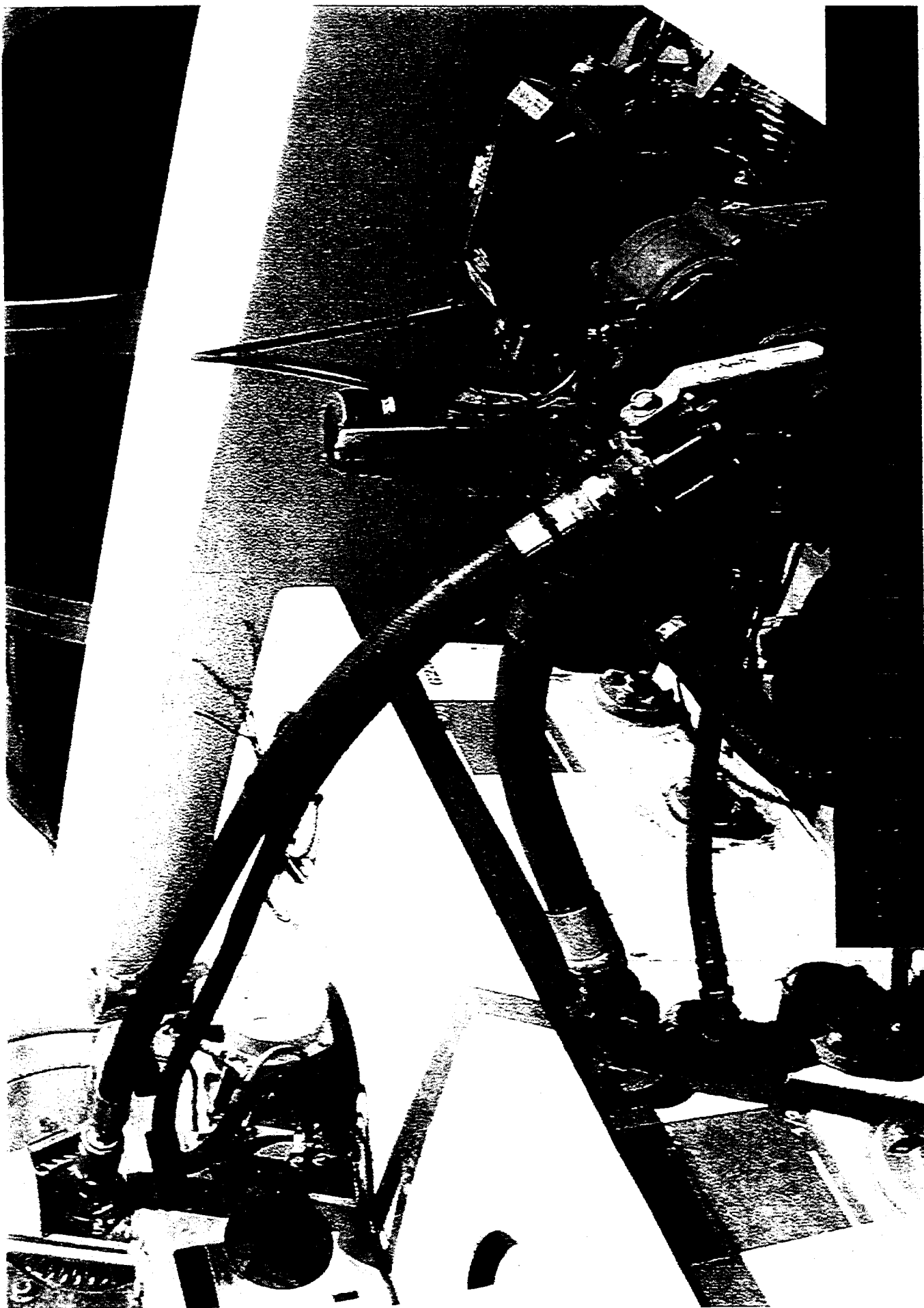
OBJECTIVES

1. Identify items to be checked on the pump and pump plumbing during daily and periodic/post fire inspections.
2. Troubleshoot and correct common problems with the pump and pump plumbing.

Pulp Engine Inspection



2-3-ENOP-PP



2-4-E:NOP-PP

What if
you don't
Have one
Of these?

2-5-1(NOP-PP

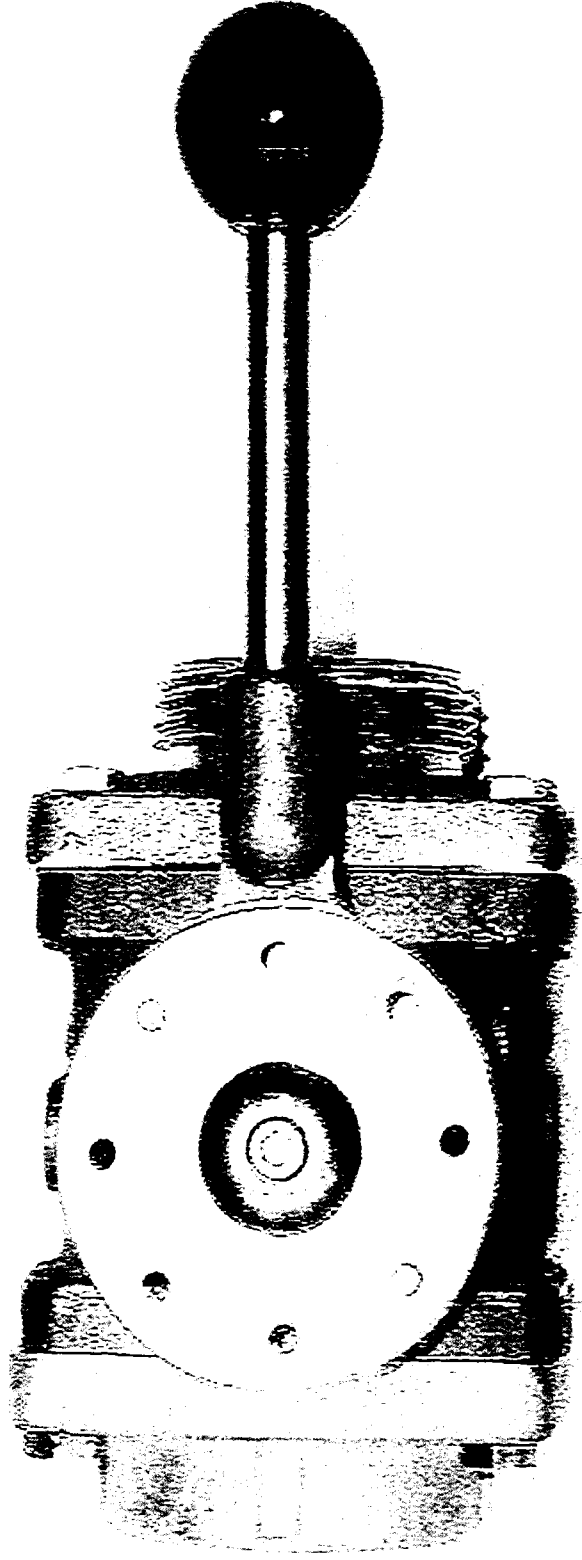




Valve Inspection

2-6-LENOP-PP

Should look like this



2-7-E:NOP-PP



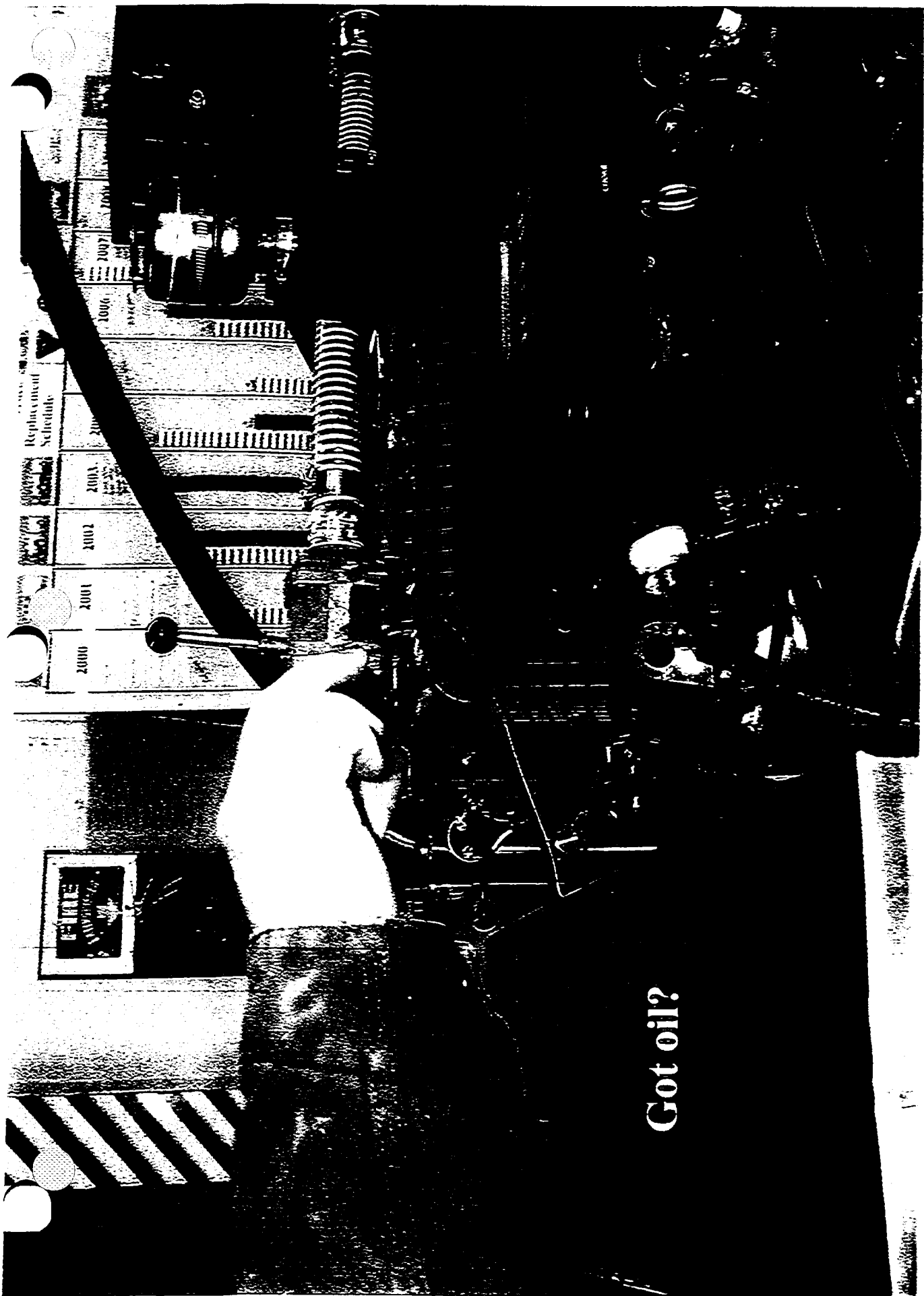
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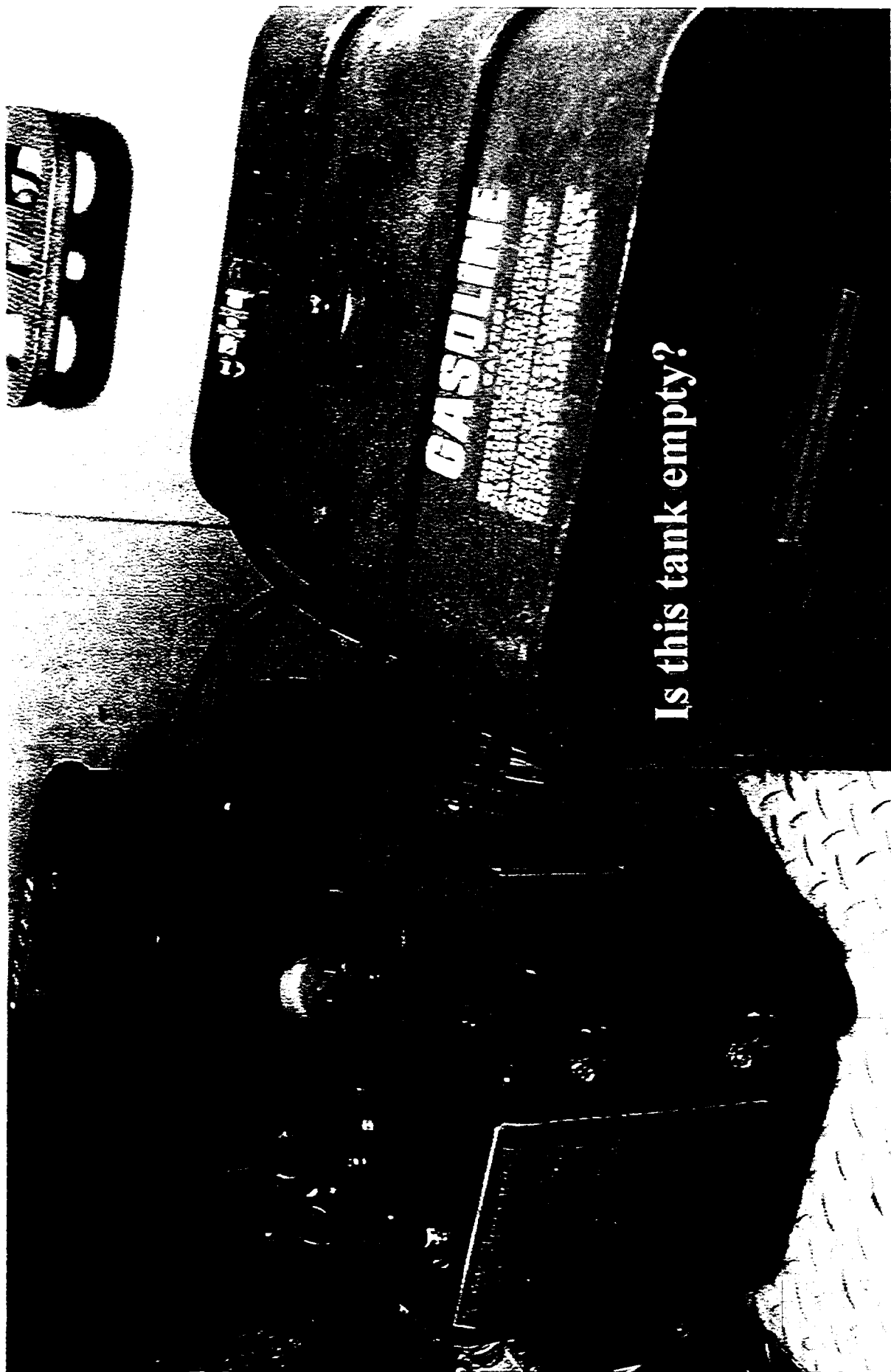
2-8-1:NOP-PP



Got oil?

2-9-ENOP-PP





Is this tank empty?

2-10-ENOP-PP



2-11-1ENOP-PP



2-12-ENOP-PP



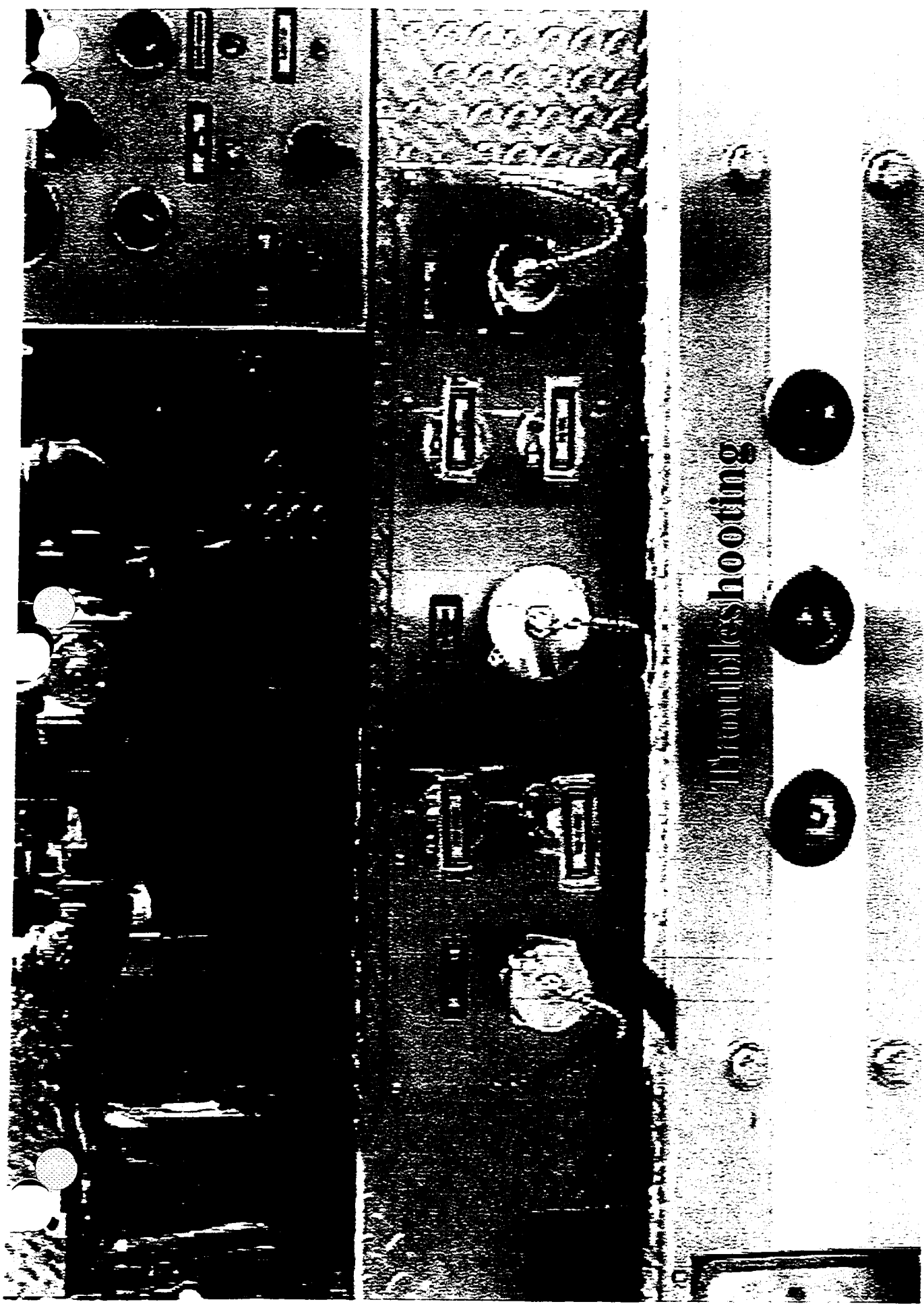


2-13-1-NOP-PP

Check primer pump



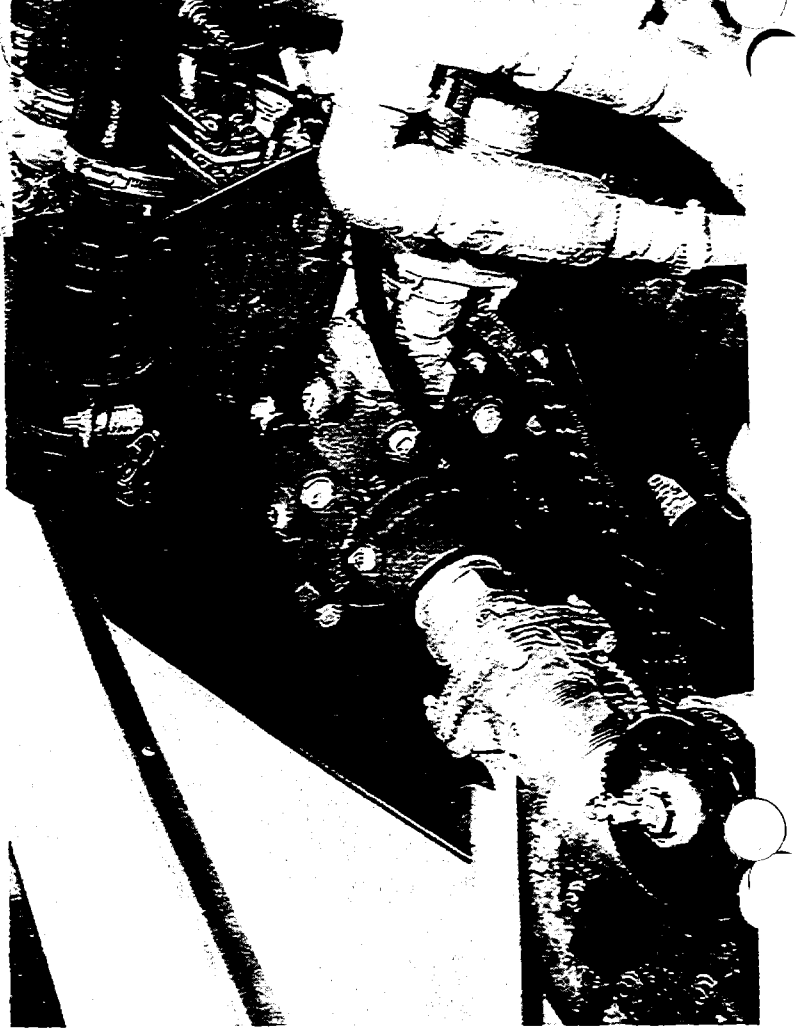
2-14-ENOP-PP



Troubles shooting

2-15-ENOP-PP

Pump Engine Will Not Start ?



- Check Switches
- Check fuel
- Choke
- Spark Plugs
- Glow Plugs



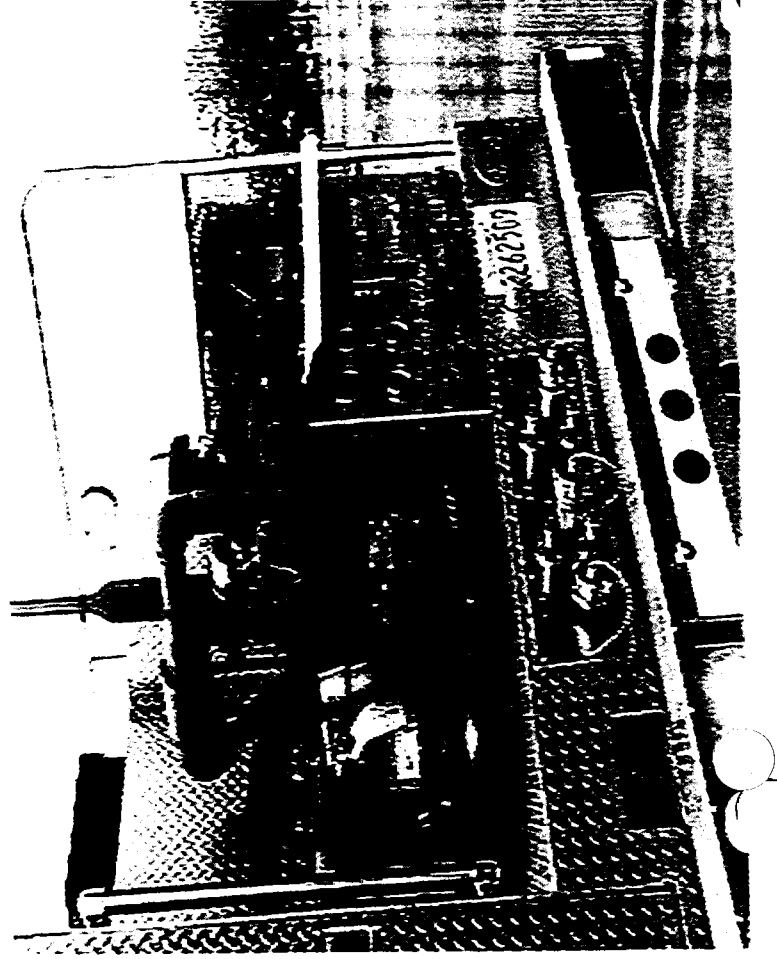


Pump Engine Starts
But Will Not Keep
Running?



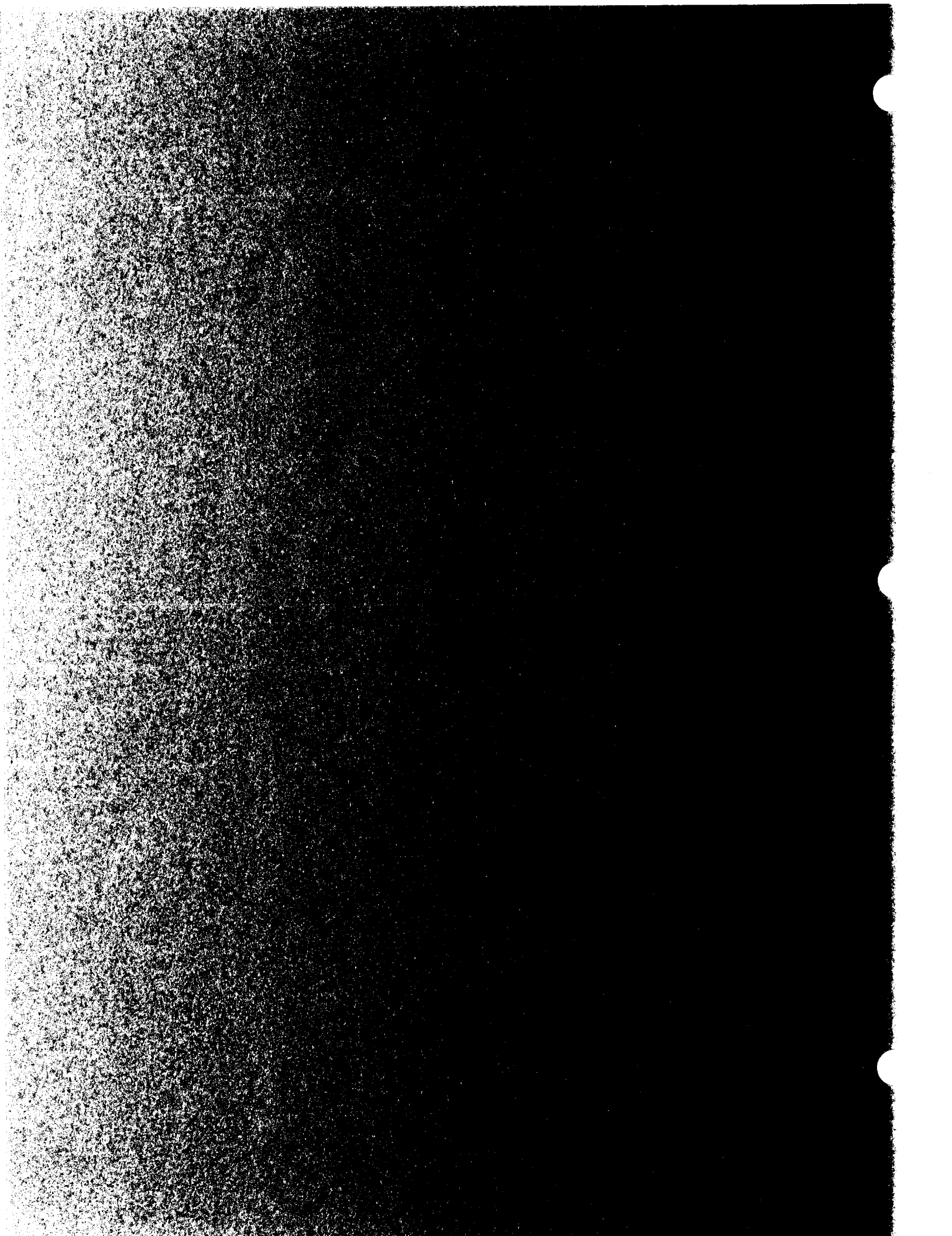
- Override switches
- Valves
- Fuel filter/Filters

Pump Engine Starts and Runs but No Water Pressure?



- Strainer
- Valves
- Pressure Gauge





Use of Snow Chains

The use of tire snow chains and the criteria for when to apply them varies widely throughout the county. Improperly applied snow chains have caused significant damage to the apparatus and delayed the response of units. This memorandum is intended to provide guidance on the use of snow chains during various types of inclement weather.

In general there are two types of chains in use in the county:

1. **Permanently installed "On-Spot" chains.**
2. **Standard removable tire chains.**

Permanently mounted **"On-Spot" chains** or "automatic chains", consist of short lengths of snow chain attached to a small drive wheel that, when activated, contacts the inside tire of the rear duals. These devices rely on centrifugal force to throw the lengths of chain under the tire. Depending on need, these chains can be raised or lowered from the cab of the apparatus. For best operation these chains **should be engaged while the unit is moving**. These chains work well when the apparatus can maintain slow but steady speeds, such as in shallow snow or on intermittently clear or covered roadways. These chains will not work well in deep snow or when conditions bring the apparatus to a crawl. **DO NOT drive faster than 30 mph when you are using "On-Spot" chains! RAISE the chains anytime that they are not absolutely necessary.** Driving at higher speeds for prolonged periods will damage or destroy the "On-Spot" assembly and will cause tire damage that may lead to failure.

Removable **standard tire chains**, also known as "drop chains", are applied manually to the outside tire of the rear duals. They must be applied so that they are well distributed around the tire and fit snugly. A video on proper installation of these chains is available. Standard tire chains offer better performance than "On-Spots" in deep snow, heavily rutted snow, and on ice. This is because they do not rely on centrifugal force to place them under the tire. Standard tire chains can be used at the same time as "On-Spots" because they affect different tires. Using both types at the same time increases the likelihood that a chain will be under the tread at any given time, and therefore increases traction. Unfortunately, standard tire chains can be very damaging if they come loose. Units utilizing standard tire chains should carry lengths of coat hanger wire or mechanic's wire (available in the shop) to secure broken sections in the event of a failure. **Plastic cable ties will not work.** In some cases, if the broken section cannot be secured, the entire chain may have to be removed before a unit can continue. The video will provide more information about broken chains and chain repair.

The following guidelines should be followed for chain usage:

Less than 6 inches of snow on the ground or predicted: Use the apparatus mounted "On-Spot" chains. Be sure to raise the chains on cleared pavement or when they are not needed for traction. Monitor the weather for changes that might produce more than 6 inches of snow and be ready to apply standard tire chains if conditions worsen.

6 inches or more of snow on the ground with more falling or forecasted: Apply the standard tire chains, and **RAISE the "On-Spots". DO NOT drive faster than 30 mph on clear pavement for any reason.** If a

chain breaks, then **STOP** the unit as quickly as possible in a **SAFE** place. Notify ECC that you are out of service until you can repair or drop the chain. Carry a snow shovel to aid in clearing snow from under the unit if a repair is necessary and to clear walkways if needed at the scene of an incident.

Blizzard Conditions: Apply and use the standard tire chains. **Do not use the “On-Spot” chains unless you are stuck and have a tire that is spinning.** Raise the “On-Spots” as soon as you regain traction. Observe the rules stated above concerning speed and chain breakage. Carry scoop and spoon shovels on the unit if possible. These shovels will allow for quicker digging through plow banks and packed drifts that would bend or break normal snow shovels.

Ice: Apply the standard tire chains and **use them in conjunction with the “On-Spots”.** Recognize that ice is by far the most dangerous road surface we have to deal with. Allow several times your normal stopping distance and reduce speeds dramatically prior to entering turns. Carry sand, absorbent, or ice melt to improve traction in small work areas and to aid you if you get stuck. **Pay close attention to other vehicles moving in your proximity.**

All personnel must monitor the condition of the roadways in their response area for changes throughout their shift, and report these changes to the on-duty station officer. This monitoring must include getting up periodically at night. All personnel should realize that changes in road conditions may force them to apply and remove chains more than once in their shift. **Authority for applying chains will rest with the on-duty station officer** unless orders are received from a higher authority. When the station officer makes the determination that chains are needed he or she will notify the on-duty Battalion Chief and the LFRD representative. Personnel driving the apparatus should remember that vehicle speed can be determined with AVR technology.

As a general rule **units running with standard tire chains should not be on the Interstate Highways** because they cannot exceed 30 mph. Driving at 30 mph on the Interstates produces one hazard, while driving at higher speeds with the chains on produces another. This rule will impact the patient transport practices of the north county stations. For this reason, the on-duty station officers and battalion chiefs should consider using one type of chained vehicle to access patients and remove them to cleared roads where they can be transferred to an unchained unit for transport. Notify ECC of your intended strategy.

ONSPOT

DESCRIPTION OF OPERATION

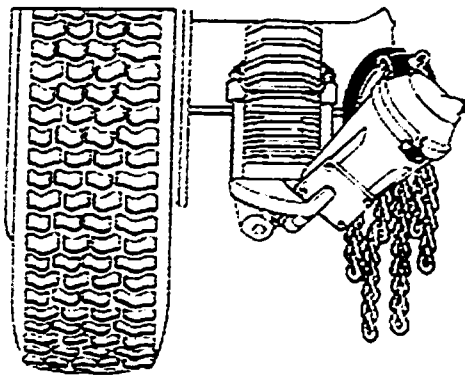
The Onspot Automatic Tire chain offers the traction of a single set of conventional snow chains at the flip of a switch, without having to stop the vehicle.

An electric switch mounted in the cab provides 12 volts to an air solenoid mounted on the vehicle's frame rail. Compressed air to the solenoid is supplied from either the vehicle's onboard air system or a 12-volt compressed air kit.

When the dashboard switch is activated, the solenoid opens allowing compressed air to enter the air chamber and lower the chainwheel so it contacts the inside of the tire. The friction between the tire and the rubber-covered chainwheel causes the chainwheel to rotate, creating enough centrifugal force to flail the chains out in front of the tire. (The principle of the system is similar to a small generator driven by a bicycle tire to operate a headlight.)

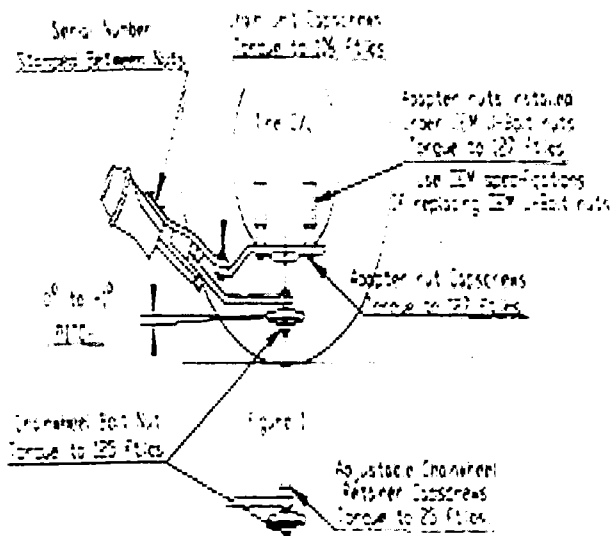
Six lengths of chain spaced at 60-degree intervals on the chainwheel ensure that there are always two (2) chains between the tire and road surface whether you are accelerating, braking or are in a wheel lockup condition. The traction from the chainwheel is obtained in forward OR reverse.

When the dashboard switch is turned off, the solenoid exhausts the air provided to the chain units and return springs in the air chambers bring the chainwheels back to their resting position.

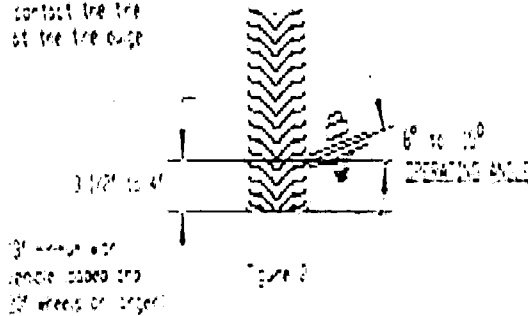




Keep your Onspots in tune General Guidelines



Chain Link should
contact the tire
at the tire edge



Red Chain Link Driver Side
Blue Chain Link Passenger Side

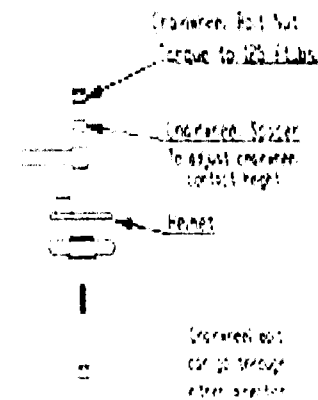
Press Air Bearings

Check Play In

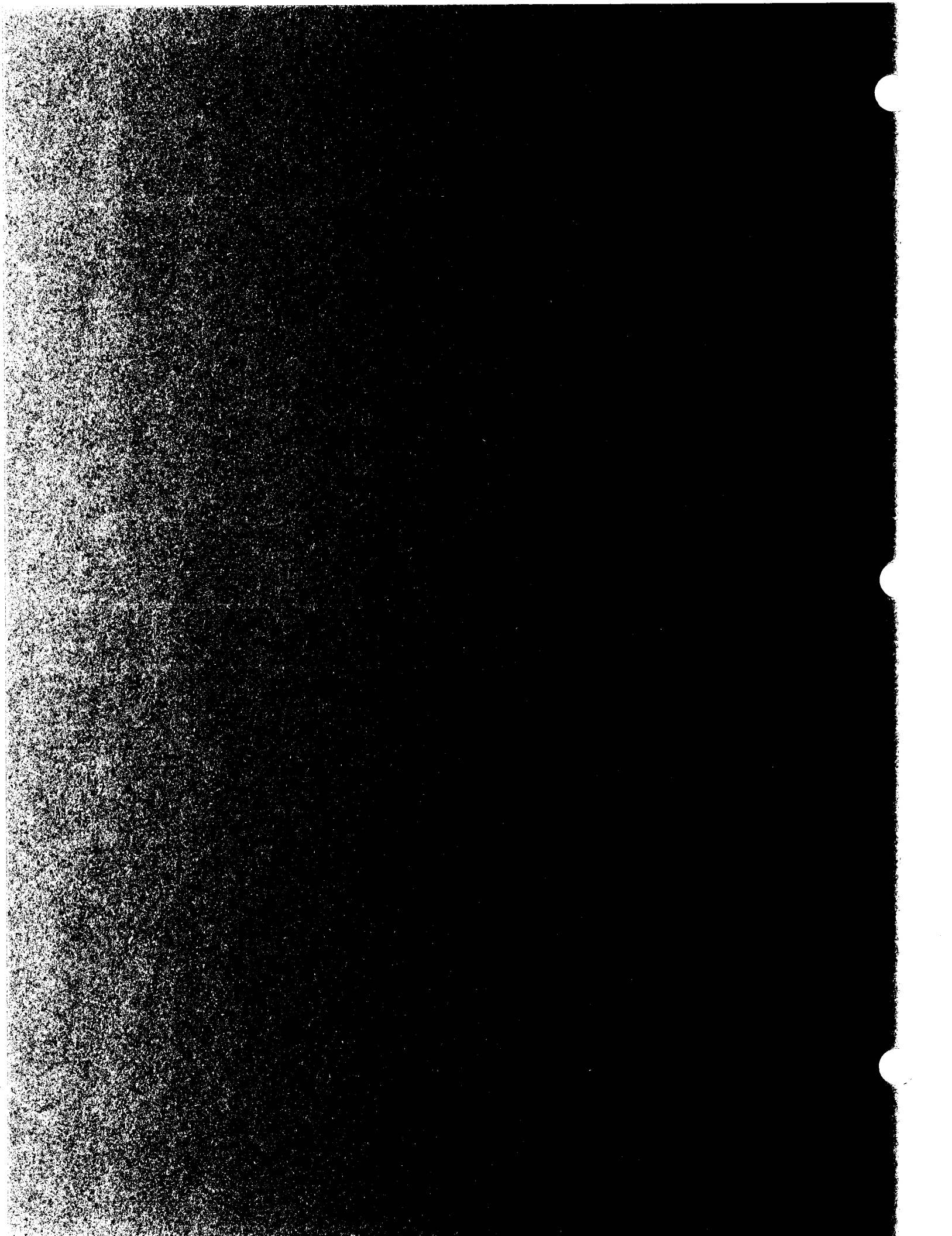
Ball Joint
Chassis Bearings
Axle Bearings

Check Tire Inflation Pressure
(Minimum 20 psi)

Check Chain Link Contact
Operating Angle
Pitch
Contact Height



1-800-221-2457



Hydraulics Review Module

The hydraulics review module is intended to provide the driver trainee a summary of hydraulics and formulas that have been taught at various times in the fire service. Currently, the MFRI Pump Operator Manual, 1998 edition is what is used for MCFRTA Pumps and Hydraulics Course.

The main difference with the MFRI Pump Operator Manual and previous manuals is the formula for calculating friction loss of attack lines. The other formulas that we have provided for calculating friction loss in attack lines are intended to expand your knowledge of the various methods that are available.

Friction Loss and Formula Review

The "Q" Formula

ATTACK HOSE LINES

$$2Q^2 = 2 \frac{1}{2}" \text{ Hose}$$

$$6Q^2 = 2" \text{ Hose}$$

$$12Q^2 = 1 \frac{3}{4}" \text{ Hose}$$

$$24Q^2 = 1 \frac{1}{2}" \text{ Hose}$$

SUPPLY HOSE LINES

$$Q^2 = 3" \text{ Hose}$$

$$Q^2 \div 3 = 3 \frac{1}{2}" \text{ Hose}$$

$$Q^2 \div 5 = 4" \text{ Hose}$$

$$Q^2 \div 15 = 5" \text{ Hose}$$

$$1100Q^2 = \frac{3}{4}" \text{ Booster Hose}$$

$$150Q^2 = 1" \text{ Forestry Hose}$$

MFRI Friction Loss for Attack Lines 30 psi Friction Loss per 100 foot Section

Size of Hose	Maximum Flow
1-1/2" Line	125 gpm
1-3/4" Line	150 gpm
2 " Line	200 gpm

MCFRS Matrix for Hand Lines Friction Loss per 100' Hose

	1 1/2" Hose	1 3/4" Hose	2" Hose
100 GPM	30psi	10psi	5psi
150 GPM		30psi	15psi
200 GPM		50psi	25psi
250 GPM			40psi

Formula Review

$$EP = NP + FL + D + (-) EL$$

Engine Pressure = Nozzle Pressure + Friction Loss + Device +(-) Elevation

$$NR = 1.57 \times D^2 \times NP$$

Nozzle Reaction = $1.57 \times (\text{Diameter of Nozzle Tip})^2 \times \text{Nozzle Pressure}$

$$GPM = 29.7 \times D^2 \times \sqrt{NP}$$

Gallons per minute = $29.7 \times (\text{diameter})^2 \times \sqrt{\text{nozzle pressure}}$

Nozzle Pressures

Standard Fog Nozzles = 100 PSI

Smooth Bore Master Stream Nozzles = 80 PSI

Smooth Bore Hand Held Nozzles = 50 PSI

Low Pressure Fog Nozzles 75 PSI

RULE OF EIGHT'S FOR SMOOTH BORE NOZZLE TIPS

This formula uses the diameter of the tip size in eighths of an inch plus a factor of 2 to rough calculate the gallons per minute flow from a smooth bore nozzle.

Example: 1" Tip = $0/8 + 2 = 200$ GPM (A 1" tip has zero eighths associated with it so it is zero eighths (0/8) plus 2 to equal 200 gallons per minute flow)

$$1'' \text{ Tip} = 0/8 + 2 \quad 0 + 2 = 200 \text{ GPM}$$

$$1 \frac{1}{8}'' \text{ Tip} = 1/8 + 2 \quad 1 + 2 = 300 \text{ GPM}$$

$$1 \frac{1}{4}'' \text{ Tip} = 2/8 + 2 \quad 2 + 2 = 400 \text{ GPM}$$

$$1 \frac{3}{8}'' \text{ Tip} = 3/8 + 2 \quad 3 + 2 = 500 \text{ GPM}$$

$$1 \frac{1}{2}'' \text{ Tip} = 4/8 + 2 \quad 4 + 2 = 600 \text{ GPM}$$

$$1 \frac{5}{8}'' \text{ Tip} = 5/8 + 2 \quad 5 + 2 = 700 \text{ GPM}$$

$$1 \frac{3}{4}'' \text{ Tip} = 6/8 + 2 \quad 6 + 2 = 800 \text{ GPM}$$

$$1 \frac{7}{8}'' \text{ Tip} = 7/8 + 2 \quad 7 + 2 = 900 \text{ GPM}$$

$$2'' \text{ Tip} = 8/8 + 2 \quad 8 + 2 = 1000 \text{ GPM}$$

Pump Pressure Calculations for Different Devices and Apparatus

Standpipe and Sprinkler Connections: 150 PSI at Base and 5 PSI per Floor unless otherwise specified on the connection.

Master Stream Devices: Nozzle Pressure + 10 PSI for the device. Older devices with multiple intakes and stream straightener Nozzle Pressure + 20 PSI.

Ladder Company Aerial Apparatus: Hose in ladder bed 3" or 3.5" and 100 feet long. Calculate the friction loss in the hose for the flow + 10 PSI for the Siamese and 10 PSI for the nozzle.

Aerial Towers: Pump per the specifications of the apparatus. If not specified use 120 PSI at the base of the tower plus the elevation. Check the gauge on the nozzle for proper pressure - 80 PSI Smooth Bore or 100 PSI Fog.

Relay Pressure: 50 PSI for 3" Hose
20 PSI for LDH

Metro Standpipe: Fill with hydrant pressure until your Master Intake and Discharge Gauge read the same pressure. Remember that the pressure down is 5 positive pounds per 10 feet of drop. You may not need to pressurize the system with your pump. Hydrant pressure may need to be gated back to compensate for the pressure.

Estimating Hydrant Capacity Formula

Static - Residual
Static

10% used $\frac{1}{3}$ used 2x water available
25% used $\frac{1}{2}$ used 1x water available

Bresnan Cellar Nozzles:

Elkhart 2½" Nine Outlet (3-9/16"; 3-5/8"; 3-1/2") – 480gpm at 100psi or 340gpm at 50psi
Elkhart 2½" Six Outlet (3-9/16"; 3-5/8") – 385gpm at 100psi or 275gpm at 50psi
Akron 2½" Nine Outlet (3-1/4"; 6-13/32") – 250gpm at 100psi
Akron 1½" Six Outlet (3-1/4"; 3-5/16") – 95gpm at 50psi

